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On the Connecticut Turnpike

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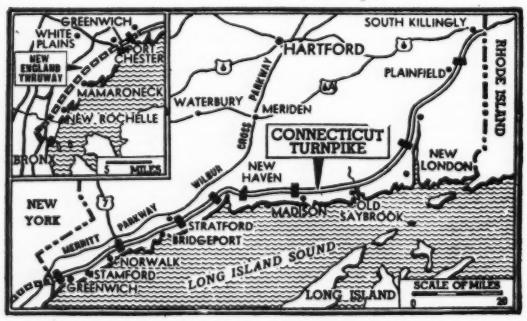

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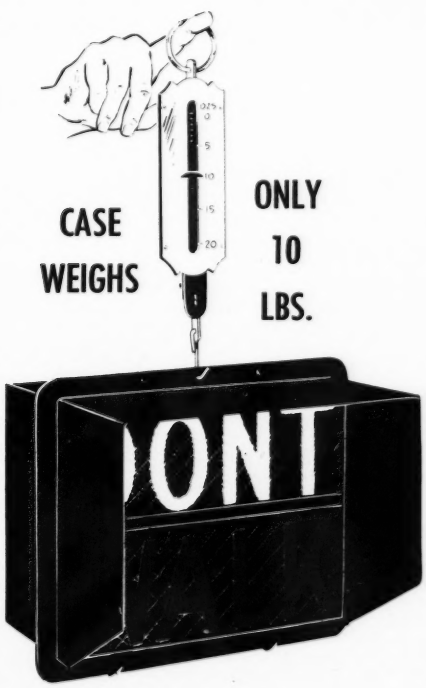

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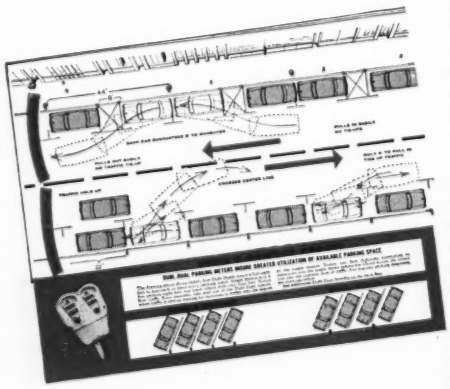

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☐ Please have your representative call.

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TRAFFIC ENGINEERING

OFFICIAL PUBLICATION OF THE INSTITUTE OF TRAFFIC ENGINEERS

Vol. 28 SEPTEMBER, 1958 Number 12

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COVER: Sunshine Skyway Bridge over Tampa Bay, Florida.
—Photo by Wade Blake, Florida State Road Department

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from coast to coast

PR

traffic signal control

TRAFFIC ACTUATED ®

Frankly Speaking . . .

FROM THE APPIAN WAY of ancient Rome to the Interstate Highway System of modern America spans more than 2000 years of technological evolution in road building.

These two historical mileposts represent more than mere physical progress. Designed to meet the road needs of their day, they represent two periods of engineering concept.

The old concept, good until today, dictated that roads be built for vehicles. From Roman chariots to the Conestoga wagon may seem long in years but both present the same problem in road design to the engineer. With the coming of the automobile and its pneumatic rubber tires, there was simply the added necessity of providing a smoother, harder, and straighter road for vehicles that moved faster every year.

But the old concept is no longer valid, and a new breed of engineer must meet the new demands of modern highway travel. The problem is no longer the simple one of speed, surface and durability for the vehicles using the road; the vital factors are now safety, control and ease for the drivers of those vehicles. Today's roads must be designed primarily for the *driver*, rather than the vehicle.

Today we stand on the threshold of a new design era —where people are the basic problem. The traffic engineer must now develop new axioms and rules to meet this problem. While the shortest distance between two points may be a straight line, today's straight line may not be the safest route to travel.

Setting up these new standards is no simple matter. Some methods of building safety into the road have been found as testified by lower accident rates on turnpikes and expressways. Though these roads have solved some problems, they have introduced others, and much more knowledge is needed before the engineer can find foolproof applications for his new highway design.

The expressway, for example, eliminated pedestrian accidents by eliminating pedestrians. Intersection collisions were eliminated the same way; but were replaced by rear-end collisions. Sight distances were increased, not only of the road ahead, but also of the adjacent landscape.

As a result, the driver lost his perception of speed which depended more than ever on the orientation provided by his peripheral vision, and this became a contributing factor to the rear-end collision.

The smooth, relatively frictionless road surface of these expressways saved wear and tear on both vehicles and drivers — to the point of hypnosis. And the automotive engineer contributed a soundless car which permitted the driver to slumber on into eternity.

Those long, straight-line stretches of road covered distance like seven-league boots — and drivers died with those boots on because they couldn't make important decisions far enough ahead to avoid disaster. At expressway speeds, individual misjudgments add up to multiple-car collisions.

So the traffic engineer must lay aside his old conceptions and solutions. He must work with new ideas and must develop new tools to provide for the deficiencies of the human being. He must reconsider the laws of physics and apply new action and reaction tables. He must learn from the errors and records of past experience and the knowledge gathered in other sciences and arts.

He can regiment the road and the vehicle but the driver is yet unknown. Man cannot be controlled by a blueprint, nor the micro-switches of a servomechanism. Man's conformance must come from within, based on his physical abilities, his emotional attitudes and his understanding of the problem.

Accordingly, the traffic engineer must be provided with a new knowledge of the human mechanism — a mechanism which is the most profoundly complex and wonderful in creation. This knowledge can be attained with sufficient time, money and effort if supported by the public.

If the 38,000 people who lost their lives on the highways of our nation last year had anything to say about it, the cost would be the smallest part of their consideration. Those fatalities conservatively cost the nation over four billion dollars. We cannot afford such annual losses.

These new roads the traffic engineer and his associates are designing must save time and money, but most important, they must save lives. This is the challenge of our times.

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This Ticket-Spitter at unattended entrance to Greensburg, N. C., lot has issued ticket and opened inside gate.

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Expanded Signal Volume Warrants

By William G. Galloway
(Jun. Mem., ITE)
Division of Traffic
Kentucky Dept. of Highways

MANY TRAFFIC ENGINEERING agencies have developed a great degree of reliance on the traffic volume warrants for signalization contained in the Manual on Uniform Traffic Control Devices for Street and Highways. The agencies frequently are forced to acknowledge that these warrants often seem inadequate, in that they apply only to two lane traffic streams, and inflexible, due to their inclusion of only one volume condition for each of the conflicting streams. This study was undertaken to expand the coverage of these volume warrants, to include four lane traffic streams as well as two, and to provide for varying volumes in these streams.

By applying the existing traffic signal warrants, the signalization of an intersection may be effected under either of two categories. These categories, which apply only to two lane-two way streets and highways are:

(1) *Minimum Vehicular Volume*

Intended for application at locations where no special conditions exist, and where the amount of intersecting traffic is the outstanding reason for intersection conflicts, these warrants are:

	Total Intersection* Volume	Total Minor Approach* Volume
Urban Areas	750 VPH	250 VPH
Rural Areas	500 VPH	125 VPH

*The total intersection and minor approach volumes must exceed these values for each of eight hours of an average day.

(2) *Interruption of Continuous Traffic*

Intended for application at those intersections where the use of a signal may aid side street traffic in moving into or across heavily traveled through highways, these warrants are:

	Main Street Volume*	Side Street Volume*
Urban Areas	750 VPH	75 VPH
Rural Areas	500 VPH	50 VPH

*The principal and side street volumes must exceed these hourly values for each of eight hours of an average day.

Few individuals charged with the approval or disapproval of traffic signal requests have failed to recognize the fact that the average motorist, when entering a heavy stream of traffic from a side street or entrance, would prefer to do so under the protection of a traffic signal. Presumably, the effect of the signal in such cases is to produce added "peace of mind" and for the traffic engineer to ignore this effect would indeed be folly. In addition to the "peace of mind" value of the signal many other variables exist, the limits of which must be arbitrarily fixed. Typical of such variables are the size of the separation (gap) in the main traffic stream that is required for side street crossings or entries, the number and occurrence of these separations with respect to the demand for them, the degree and proportionality of main and side street delays that can be economically tolerated, and the maximum time that any driver should be expected to be delayed under this condition of proportionality. Because limits for these variables have been established, even though arbitrarily, in the existing traffic volume warrants, no attempt has been made in this study to evaluate or question their treatment.

The data collection for this study was limited so as to provide information regarding the volume by short time intervals of the main traffic stream and the volume of the intersecting or entering stream during the same period. Data was also collected to indicate the time spacing of all vehicles in the main stream and to indicate the length of the gaps in this stream which were used for side street movement. This data was collected for many volume ranges, including those both greater and smaller than the levels at which the installation of a traffic signal would be considered warranted.

All studies were made at isolated intersections which could be considered average, that is, not affected by such factors as sight distance restriction, or steep approach grades. To eliminate the variable impairment of crossing conflicts, only "T" type intersections were studied, and in all cases the side street entered the main street from the 90° stem of the "T." To eliminate the variable effect of median treatment differences, studies were made at locations having both narrow medians and wide medians and at other locations without median treatment of any type.

Specifically, data was collected at locations where 400 to 1800 vehicles per hour approached the intersection at from 30 to 35 miles per hour on the two and four lane main street approaches and where 10 to 190 vehicles per hour were required to stop on the two lane side street approaches to the intersection. Channelization including a shadowed left turn lane on the main street was provided at one study location.

The first phase of the analysis was intended to give a description of the size gaps in the main stream which were desired by side street motorists for left turns. The second step in the analysis was to determine the number of gaps of a size sufficient for side street left turns that were present in main street traffic streams of different volumes. The purpose of the final phase of the analysis was to correlate the values determined in the previous phases, and to determine, upon the

basis of side street gap demand and main street gap availability, the various side and main street volume ratios that would warrant signalization.

One portion of the analysis which may be noteworthy was the determination of an accurate description of the minimum gap size requirement of the side street motorist. A true description of this requirement could not be gained by studying the gaps actually used for side street maneuvers because in many instances, gaps of long duration in the main stream were available to side street motorists immediately upon approaching the intersection. However, by arranging the gaps refused by each side street vehicle in a frequency distribution, the gap size *not* refused by the majority of side street motorists was determined. Applying converse reasoning, it was concluded that a gap of such size as to be *not* refused by a majority of the side street motorists must represent the minimum size gap that would be acceptable to them for their maneuvers. The ninety percentile value was chosen for the purpose of this study to indicate the gap size that was not unacceptable to the majority of side street motorists desiring to turn left into the main traffic stream. Only left turns were considered in that longer gaps were required for this movement than for right turns, this maneuver representing therefore, the more critical of the two movements.

From this phase of the analysis, it was found that a six second gap in the average main stream of two lanes would be acceptable and that a nine second gap in the average major stream of four lanes would be considered acceptable by the majority of side street motorists for entering the major stream. On four lane facilities, it was found that a gap of approximately one second less or eight seconds, would be adequate if a median wide enough to accommodate an acceleration lane for left turns were employed on a major street. Similarly, a gap of about one second more or ten seconds would be required at location where the four lane highway was not divided or where the median was not wide enough to adequately shadow side street movements. The differences between gap requirements for the two and four lane facilities may be partially explained by the difference in complexity of operations on the facilities and by the additional travel distance required when entering the four lane facility from a side street.

The typical gap distribution on two and four lane facilities which was found during the study is shown in Figure 1. From these data, it is apparent that, where the influence of the smaller gaps is great, four lane facilities present a greater number of gaps than do two lane facilities. However, as the influence of the short gap wanes, the number of gaps presented by the two types of facilities approach equality until at the time that the influence of the smaller gaps is entirely eliminated, the two lane facility presents a greater number of gaps for all volume conditions. This condition, though somewhat unexpected, results undoubtedly from the fact that the two lane facilities tend to lose their free flow characteristics at lower volume levels than do four lane facilities.

(Continued on page 35)

GAP DISTRIBUTION ON
TWO AND FOUR LANE FACILITIES

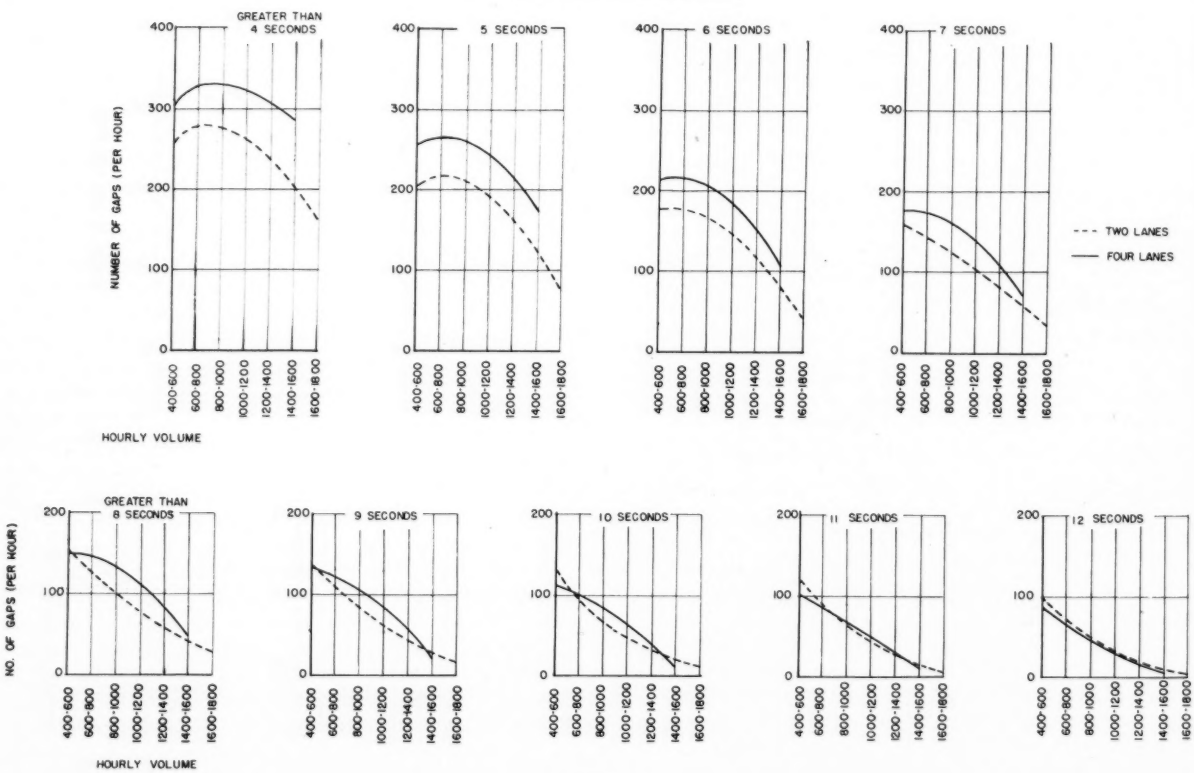


FIGURE 1

28th Annual Meeting
Miami Beach, November 11-13

PLANS FOR the 28th Annual Meeting of Traffic Engineers in Miami Beach next November are rapidly taking shape. The meeting will be held at the Deauville Hotel, with the first convention-wide affair held at noon on Tuesday, November 11. The meeting will close with a banquet on Thursday, November 13.

Many Institute members will attend, with a substantial number planning to bring their wives. The meeting is not limited to members of the Institute, however, and engineers and others interested in the profession and the organization are welcome to attend. Estimates of possible attendance have run as high as 1000, although if this total were reached it would represent the largest annual meeting yet held.

Many members will plan to arrive in Miami on Monday, November 10, or even on Sunday, because technical committees will be meeting on Monday, along with the Board of Direction. Specific committee meetings will be announced to committee members, but meetings will be open and all members are invited.

The first formal event of the convention will be an opening luncheon on Tuesday. This will be followed by the first technical session, which will feature a keynote speech by W. F. Babcock, North Carolina Director of Highways and two award-winning papers, the Matson Award and the Past Presidents' Award. This will be the first public announcement of the names of the winners. Last year, in Detroit, O. K. Normann was the Matson Award recipient, and Eugene J. Lessieu won the Past Presidents' competition.

On Wednesday the technical sessions will continue with a morning meeting. The program will include a paper on traffic operations on freeways by C. C. Robinson, who has been serving as secretary of the Institute's Freeway Seminar Steering Committee. This will be followed by a two-part discussion on uniformity of signs, signals and markings, in which two speakers will take opposite views of whether or not we are really achieving the proper kind and degree of uniformity in this field. George W. Howie of Cincinnati and E. R. Ricker of the New Jersey Turnpike are the debaters here.

The famed Miami skyline, as seen at night from the beach. —City of Miami News Bureau

Also scheduled for discussion on Wednesday morning is the subject of metropolitan area traffic organization, with speakers from two of the outstanding examples in the world — one from Toronto and one from Dade County, Florida (the Miami area). Speaking from the standpoint of an overall administrator will be O. W. Campbell, Dade County Manager and former San Diego City Manager. Speaking as a traffic engineer in an area in which the plan is operating now will be Sam Cass, traffic engineer for the Municipality of Metropolitan Toronto. The great interest in this idea of "metro" government will mean that this subject should be very popular.

On Wednesday afternoon the annual business meeting of the Institute will be held, including reports of the officers, election of new officers and directors, and discussion of other business scheduled to come before the meeting. The session is open only to members of the Institute, the only session of the convention so restricted.

On Thursday morning the six technical departments of the Institute will hold separate sessions. Each department head is arranging a program, which will be announced in detail in advance of the meeting. The six departments meeting are: Professional Standards, Administration and Education; Traffic Control Operations (Measures); Traffic Control Operations (Devices); Planning and Geometric Design of Traffic and Pedestrian Ways; Planning and Geometric Design of Terminal Facilities; and Design and Standards for Devices, Equipment and Materials. Delegates will attend the session of their choice.

Thursday afternon will feature a number of timely and interesting subjects, including a paper by D. L. Gerlough of the University of California's Institute of Transportation and Traffic Engineering on computer applications to the traffic engineering field. Also on the afternoon session will be a panel discussion of electronics as applied to vehicle control. Represented on the panel will be the electronics industry, the automobile industry, and traffic engineering. Both subjects are challenging, and will be of wide interest.

A third portion of the program on that session will be built around the topic of forecasting traffic. This will be approached from the standpoint of the planner, responsible for developing certain basic land use information, and the traffic engineer, who makes

One of the most beautiful areas on the Sunshine State Parkway, Florida's Turnpike, is the Delray Interchange. Toll plaza is located at the right opposite small peninsula which juts out into man-made lake. —Florida State Turnpike Authority

his traffic estimates on the basis of this land use data.

Also on the technical program is a paper on metropolitan traffic planning by K. S. Vaughan-Birch, Traffic Engineer of Vancouver, B. C.

The technical sessions have been the responsibility of a committee headed by Vice President E. G. Wetzel. Committee members were R. J. Allen, D. S. Berry, Karl A. Bevins, J. E. P. Darrell, J. Al Head, D. Grant Mickle, Earl J. Reeder, E. R. Ricker, Paul L. Ristroph, C. C. Robinson, S. S. Taylor, and Wayne N. Volk.

The less formal but nonetheless valuable side of the convention has not been overlooked. This portion of the program, which recognizes that part of all conventions is the opportunity to discuss mutual problems with your fellow sufferers, has been planned by a local committee headed by George H. Kunde, Traffic Engineer of Miami, and his co-chairman, Earl J. Reeder.

Members have already been told of some of the non-technical programs being planned. This early information has gone out in the mailings from Miami Beach, but they have of necessity been sketchy.

The first affair will actually precede the official opening of the technical sessions, since it will take place on Monday evening, November 10. It will get underway at 9 p.m. in the Napoleon Room of the Deauville Hotel, a justly famous rendezvous for knowing citizens of the Miami area.

A portion of the "beach" at Miami Beach. —Florida State News Bureau

Present arrangements call for the appearance of the five-piece Al Raye Orchestra, the Vocalaires Trio and two charming young ladies as soloists. This is a first-rate show and will be enjoyed by all members and the families. Refreshments and dancing will be the order of the evening, with the party breaking up at one o'clock. Hosts for the evening will be the ARBA group.

On Tuesday, a poolside party is planned by the Deauville's own famous pool. Dancing and refreshments will again be available, but the chief interest will be provided by a water show which will feature some particularly spectacular acts. A group of signal and related companies will be the hosts for this affair.

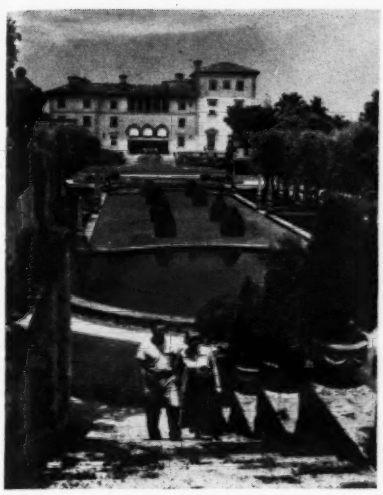
Wednesday afternoon, when the men are engaged in meetings, the wives and families will have a choice of three excellent guided tours of the area, with all transportation provided. Everyone will gather first at the Dupont-Tarleton, Miami's newest hotel, for luncheon. The tours will all depart from this hotel following lunch, with three possibilities offered:

(1) The Parrot Jungle trip, which means a visit to a tropical wonderland with beautifully landscaped grounds abounding with rare and exotic plants. Superimposed on this background are vividly colored parrots and other tropical birds. The parrots are trained and give several performances during the afternoon. Be sure to bring color film in your cameras.

(2) The Seaquarium, which is located on Virginia Key, is South Florida's largest and most complete aquarium. All the intriguing marine life of the Caribbean is featured.

(3) The Dade County Art Museum, or Viscaya, is a replica of an 18th Century Italian palace. The building and the formal gardens are among the most beautiful in the country. A camera is a must at Viscaya.

Wednesday evening has been left open for the members, with no scheduled program of any sort planned. Members and guests will have a chance to visit some of the hundreds of interesting spots. Miami and Miami Beach are renowned for their variety of shows and entertainment.



Villa Viscaya, plush estate of the late farm machinery tycoon James Deering, is now the home of the Dade County Art Museum.
—City of Miami News Bureau

Thursday, the final day of the meeting, offers a series of planned events. A brunch and a fashion show is planned for the ladies in the morning at the Deauville. A cocktail party for all members will be given in the afternoon, preceding the banquet in the evening at the Deauville.

It is anticipated that many members and families will remain in Florida for several days or more, some for the balance of their vacation. Complete tourist information will be available at the Deauville and all other hotels in the area. There will be many things to do and see, and your Florida hosts will give you all the advice and help possible in planning a trip be it short or long.

Those making their first visit to Miami will find it a fascinating city, with much to do and see. Miami, and its sister community, Miami Beach, are both young cities spawned little more than three decades ago when Henry M. Flagler pushed his railroad operations southward. Since that time, Greater Miami has grown to a lusty metropolis, world-famed as a subtropical playground and now becoming known as a center for comfortable tropical living.

For many years, Miami has been known only as a winter playground, but all that has changed now. With the advent of low-cost rail and air coach travel, it became a year-round resort within the reach of all Americans. Then, following World War II, thousands of families moved southward attracted by the healthful, outdoor living popularized there.

They are sustained by a well-balanced economy supported by diversified activities in business, commerce, manufacturing and agriculture. Miami has little heavy industry but there has been a tremendous upsurge in the number of light manufacturing plants in recent years. Construction also produces additional income for the more than 800,000 persons living in Greater Miami.

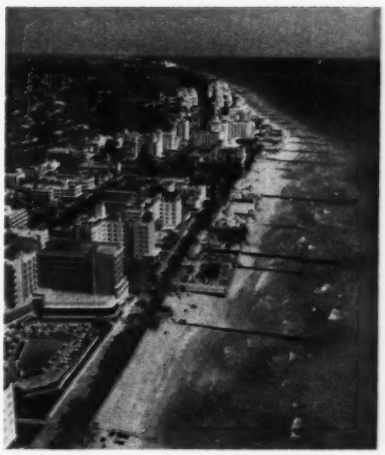
But fun-in-the-sun is Miami's best-known commodity and convention delegates should be prepared to get in their share along with other diversions, including collegiate football, legitimate theater, art exhibits and regattas on tap.

In addition, the fabulous night clubs and restaurants to suit every taste in Miami and on Miami Beach, will prove attractive to visitors.

Convention delegates who also happen to be football fans will want to take a look at the famed University of Miami Hurricanes. Early-bird conventioneers can see them Nov. 7 when they tangle with their traditional rivals, Florida State University. Then on Friday, Nov. 14, they will meet the powerful University of Maryland eleven. Both games will be played in Miami's famed Orange Bowl Stadium, site of the annual New Year's Day clash.

Following the convention, many delegates will spend at least a "long weekend" in getting home. The Miami area as well as the entire State of Florida offer many opportunities.

Many will travel over the newly-constructed Sunshine State Parkway, which runs from Ft. Pierce to Miami. And, most convention delegates will want to see the operation of the city's new radar-controlled signal system, the new "PR" setup, and the ambitious off-street parking program recently inaugurated by the City of Miami.



Miami Beach "hotel row" looking north toward the Deauville Hotel. —Florida State News Bureau

Many fine beaches ring Miami including Matheson Hammock and Crandon Park. The latter is also the site of a fine zoo, picnic facilities and an amusement park.

Miami is the center of an area known throughout the world for its fine game fishing. Visitors can charter boats at Pier Five in Miami's Bayfront Park for a day battling the big game fish in the Gulfstream, or fish from the numerous bridges and piers in the area. There is also fine fresh water fishing in the canals, lakes and rivers surrounding Miami.

The culturally inclined will be able to sample Miami's fall concert and theater season at Dade County Auditorium, the University of Miami Ring Theater and the Coconut Grove Playhouse.

The Institute of Traffic Engineers

cordially invites

You

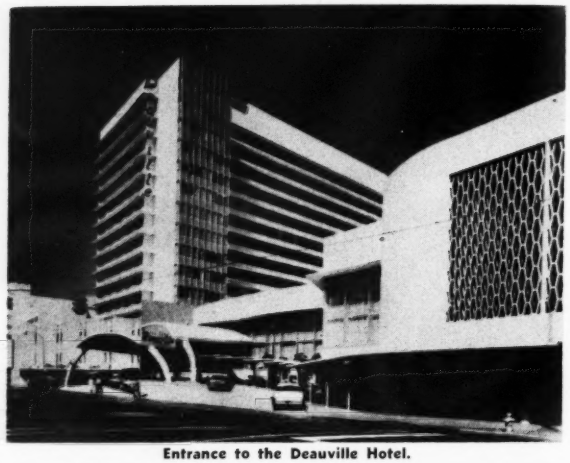
to its 28th Annual Meeting

November 11-13, 1958

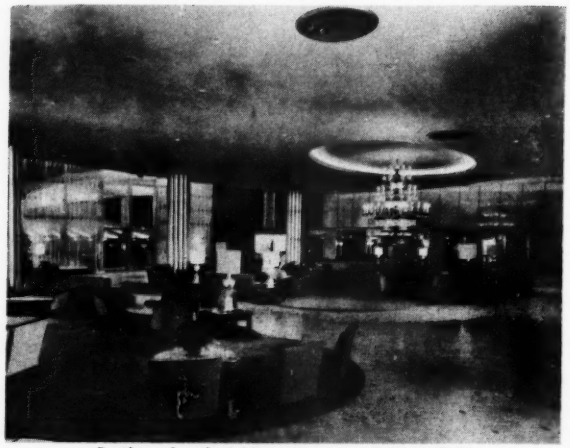
Miami Beach, Florida

For reservations, write:
Deauville Hotel
67th & Collins Avenue
Miami Beach, Florida

VIEWS OF THE DEAUVILLE HOTEL

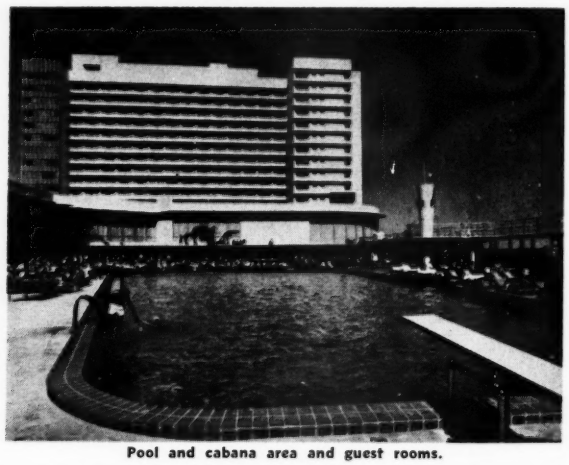


Entrance to the Deauville Hotel.



Portion of main lobby, entrance and front desk.

Richelieu Room (from room entrance towards ocean windows).



Pool and cabana area and guest rooms.

Membership Applications

APPLICATIONS FOR TRANSFER

BORTON, Weldon L.
Highway Traffic Engineer III, Michigan State Highway Department, Stevens T. Mason Building, Lansing, Michigan. July 28, 1958 for ASSOCIATE GRADE.

HUDSPETH, Vealess F.
Highway Research Engineer, Colorado Department of Highways, 4201 Arkansas Avenue, Denver 22, Colorado. August 6, 1958 for ASSOCIATE GRADE.

NOERR, Karl
Highway District Traffic Engineer, Virginia Department of Highways, Box 671, Culpeper, Virginia. August 4, 1958 for ASSOCIATE grade.

NEW APPLICATIONS

BARLOW, Thomas G.
Acting Traffic Engineer—City. 125 Armory Street, Springfield, Massachusetts. July 8, 1958 for ASSOCIATE grade.

BERGENDOFF, Carl R.
Project Planning Engineer, Howard, Needles, Tammen & Bergendoff, 1805 Grand Avenue, Kansas City 8, Missouri. July 28, 1958 for ASSOCIATE grade.

BLACKBURN, Jack B.
Engineer, Harland Bartholomew & Associates, 317 North 11th Street, St. Louis, Missouri. July 25, 1958 for ASSOCIATE grade.

BLUNDEN, William R.
Professor of Traffic Engineering, The New South Wales University of Technology, P. O. Box 1, Kensington, Sydney, N.S.W., Australia. July 18, 1958 for ASSOCIATE grade.

BOYCE, Lindsay B.
Traffic Engineer, Auckland City Council, Town Hall, Auckland, New Zealand. July 14, 1958 for MEMBER GRADE.

BREUER, Robert
Junior Civil Engineer, Department of Traffic, 100 Gold Street, New York 38, New York. August 6, 1958 for JUNIOR grade.

BUSTAMANTE, Enrique
Assistant Traffic Engineer—City, 118 South Campbell Street, El Paso, Texas. August 4, 1958 for JUNIOR grade.

CASSERA, Vincent I.
Traffic Engineer and Director of City Planning—City, City Hall, 76 Bayard Street, New Brunswick, New Jersey. August 1, 1958 for JUNIOR grade.

COFER, John I, III
Associate (Junior Partner), Harland Bartholomew & Associates, 317 North 11th Street, St. Louis 1, Missouri. July 21, 1958 for ASSOCIATE grade.

DECKER, James D.
Highway Engineering Trainee, Virginia Department of Highways, 1221 East Broad Street, Richmond 19, Virginia. July 15, 1958 for JUNIOR grade.

DODGE, Robert J.
Highway Engineer II, N. C. State Highway Commission, Highway Building, Raleigh, North Carolina. July 17, 1958 for JUNIOR grade.

DUNIVAN, Robert E.
Assistant Engineer of Traffic, Florida State Road Department, Holland Building, Tallahassee, Florida. July 18, 1958 for JUNIOR grade.

HULME, Henry S., Jr.
Traffic Engineer, Arlington County Court House, Arlington, Virginia. July 16, 1958 for JUNIOR grade.

KENIG, Neil S.
Traffic Enginer I, Bureau of Street Traffic, 321 North LaSalle Street, Chicago, Illinois. August 6, 1958 for JUNIOR grade.

MASON, William G.
Traffic Engineer I, Traffic Engineering Department, Room 215, City Ha'l, Chattanooga, Tennessee. July 16, 1958 for JUNIOR grade.

RUHL, Buford B.
Engineeringg Designer, Traffic Enginering Division, 3343 Pan American Drive, Miami 33, Florida. July 25, 1958 for ASSOCIATE grade.

SALAZAR AGUILAR, Sergio
Chief in charge of Traffic & Statistics, Ministry of Communications & Public Works, Xola & Universidad Streets, Mexico D. F., Mexico. July 14, 1958 for ASSOCIATE grade.

SCHOFER, Ralph E.
Traffic Engineer, Burgess & Niple, Consulting Engineers, 2015 West 5th Avenue, Columbus, Ohio. July 14, 1958 for JUNIOR grade.

SCOTT, Walter S.
Assistant Transportation Engineer, Porter, Urquhart, McCreary & O'Brien, 568 White-Henry-Stuart Building, Seattle 1, Washington. July 8, 1958 for JUNIOR grade.

WEISSTUCH, Donald N.
Junior Civil Engineer, Department of Traffic, 100 Gold Street, New York 38, New York. July 11, 1958 for JUNIOR grade.

Research as Applied to Traffic and Transportation

By K. A. Stonex
Asst. Director, General Motors
Proving Ground, Milford, Mich.

THE MOST important part of problems in applied research is an analysis in terms of what we know now, how we are applying what we know, and what additional information we need. Consideration of the proper emphasis on application of known data and research for new is basic. Obtaining the necessary new data may be one of the most straightforward parts of the problem.

The primary elements of useful research in traffic and transportation have to do with the rapid and safe flow of traffic; with Greenshields[1] we recognize the relation of quality of traffic flow and safety.

What Do We Know Now?

A. *Flow of Traffic*

Probably the most amazing aspect of traffic in the United States is the tremendous volume. In 1957 650 billion miles were run by about 66 million vehicles. The quality of flow of a part of this traffic must be considered to be very good. Turnpikes or freeways extend almost unbroken from Maine to Chicago, and there are a few hundred miles of freeways in the larger metropolitan areas.

As a research approach we are more interested, however, in those regions where the flow of traffic is unsatisfactory.

In 1956 a panel of the Automobile Manufacturers Association had occasion to survey the characteristics of traffic in Los Angeles.[2] Figure 1 is a map of the Los Angeles metropolitan area for reference. Figure 2 is a summary of charatceristics of flow on several types of Los Angeles streets, ranging from the freeway at an off-peak period, to the residential and business districts during periods of normal and heavy congestion. This chart shows percentile distributions of speed; quality of flow is expressed here in terms of the average speed. On the freeway at the off-peak period, the average speed was nearly 49 mph, while on the residential route, it was 15.7 mph, and in the business district, 13.2 mph. Carmichael and Haley[3] made observations of traffic flow on various Detroit streets in 1950, before any part of the Detroit Expressway System was in service. The speed distributions of several Detroit streets are shown on Figure 3 in comparison with several Los Angeles streets of somewhat the same functional characteristics. This close comparison suggests that geographical distinctions are not significant in terms of the free flow of traffic.

The relative economy of operation under these varying flow conditions is shown in Figure 4, which gives percentile distributions of fuel consumption as a function of speed, and the average economy in miles per gallon over the typical routes. Again the freeway is outstanding and the residential and business routes are far less satisfactory. Comparable results were shown on Detroit streets during a period of congestion; in both cities congestion costs time and money.

The general problem of elimination of congestion in streets is quite straightforward and it merits no extensive research activity. The solution to the problem is to expand the street system to the point where it can carry the volume; no other solution can be considered as more than partial. However, effective expansion requires a world of detailed research in routes, priorities, estimates of future volumes, origins and destinations, urban planning, and others.

Figure 1

B. *Safety*

It has been recognized by thinking people for many years that the toll of death and injury on the public highways is a major social problem. This has received increasing attention, and the fatality rate has decreased stead-

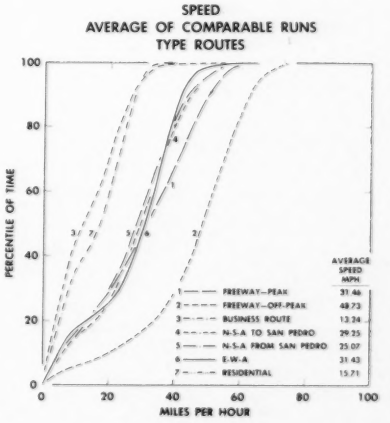


Figure 2

1 Greenshields, Bruce D., "Highway Accidents Reviewed." Paper presented at Michigan Highway Conference, Grand Rapids (1958).

2 Stonex, K. A., "Survey of Los Angeles Traffic Characteristics." *Proceedings of the Highway Research Board*, Vol. 36 (1957).

3 Carmichael, T. J., and C. E. Haley, "A Study of Vehicle, Roadway, and Traffic Relationships by Means of Statistical Instruments." *Proceedings of the Highway Research Board*, Vol. 30 (1951).

This paper was presented at the Tenth Missouri Traffic Conference, held at Columbia, Missouri, May 21, 1958.

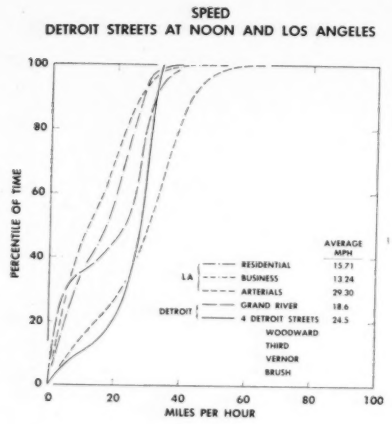


Figure 3

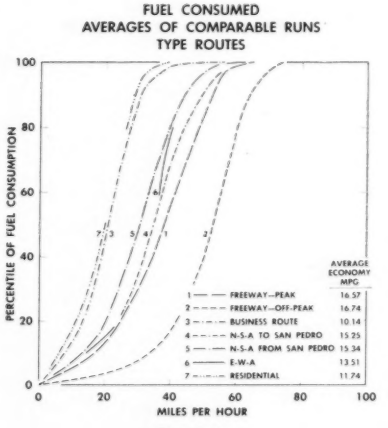


Figure 4

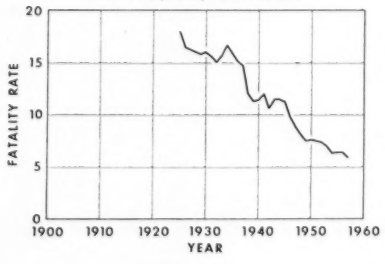


Figure 5

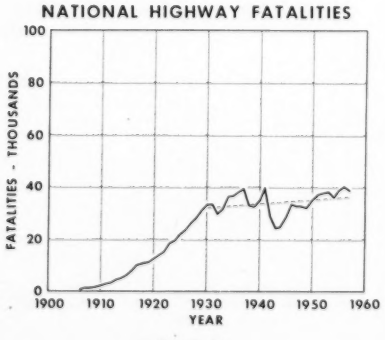


Figure 6

ily from the time that records were first kept. From a rate of 18 per 100 million miles in 1925, it has fallen to slightly below six for 1957, as indicated on Figure 5.

This declining rate was accompanied by an explosive expansion in traffic volume and total miles travelled, so that the total number of traffic fatalities increased rapidly until about 1930 (Figure 6). In 1930, there appears to have been a major breakthrough, and from 1930 to 1957 the total number of fatalities has increased slowly, at the rate of something like 130 per year.

The magnitude of the successful efforts to stem this tide can best be visualized by a configuration such as Figure 7. This shows that if the average rate from 1920 to 1930 had continued through 1957, there would have been a total of about 88,000 fatalities in 1957.

There is a wide variation in the mileage death rate just as there is in the quality of traffic flow: In 1956 the rate varied from 2.3 per hundred million miles in Rhode Island, to 10.1 in Arizona, and the national rate was 6.4. The urban rate was the lowest on record, 3.4, and the rural rate rose to 8.7. The death rate on limited access facilities was approximately one-half the national rate.

How We Are Applying What We Know

A. *Traffic Flow*

We are observing the application of knowledge in a concerted effort to improve the traffic-bearing facilities of the country. Major turnpikes span the East-North Central part of the country, and freeways are being constructed in almost every major urban center. The Federal Highway Act of 1956 will provide means whereby a 41,000-mile inter-state system of Federal and defense highways with controlled access will link all the large and medium-size cities in the country within the next decade or two. There is an accelerated program in construction of A-B-C roads.

The surge of construction of Federal and state highways is possibly exceeded by city and village street improvements, and there is hardly a city in the nation that is not undertaking some street program. It appears that we have concluded that we pay for better roads and streets, whether

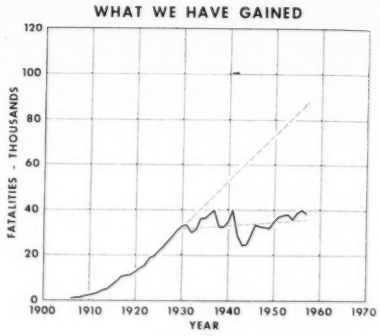


Figure 7

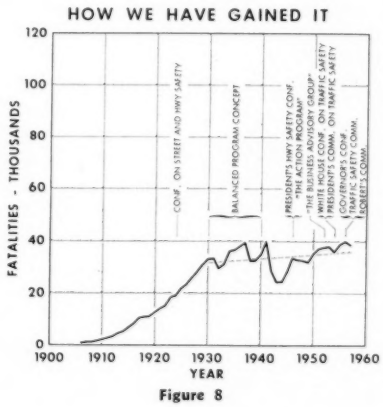


Figure 8

we have them or not, and that we may as well have them.

In order to improve the effectiveness of existing facilities, most cities, even smaller ones, have engaged professional traffic engineers, and elaborate traffic control systems have been installed and expanded time and again. The use of one-way streets has greatly facilitated the flow of traffic, even in small communities. Parking has been eliminated or reduced and controlled to free the roadway for the passage of vehicles. Zoning laws have been established widely to require provision of off-street parking proportional to new construction. The general problem is being solved by a determined application of time and money.

B. *Traffic Safety*

Figure 8 is a reproduction of the data in Figure 6 with notations of the dates of concerted movements to reduce traffic fatalities. The first apparent effective move was the so-called balanced program of engineering education, and enforcement, resulting from the 1924 Conference on Street and Highway Safety. This became effective in 1930 on a broad scale, and it has been succeeded by increasingly

more powerful organizations, including the active attention of the Governors' Conference in 1956 and 1957.

On April 1 of this year, Mr. Harlow H. Curtice, Chairman of the President's Committee for Traffic Safety, stated at the Midwestern Region of the Citizen Leadership Conference[4] that we could reduce the traffic toll by one-half within a comparatively short time if we applied what we know now. Figure 9 shows what the trend can be on this basis. Mr. Curtice was referring particularly to the splendid achievements which have been attained by local traffic safety organizations, of which we may consider those of Detroit and Chicago as outstanding examples. The traffic toll in Detroit was reduced from 396 in 1927 to 179 in 1957. This is a reduction of 55%, and this in spite of the fact that the number of vehicles increased by more than six times.

In Chicago in 1952, when the traffic safety organization was just getting under way, 458 people were killed in traffic accidents; in 1957, the number was 318, which was 30% fewer than in 1952 and the lowest total number since 1916.

The National Safety Council has conducted a poll of cities and states to determine what factors were responsible for the reduction in traffic deaths in 1957.[5] The mayors of leading cities in this reduction generally attribute a great deal of the gain to results of the programs established by local traffic safety organizations.

The big cities cut their traffic deaths more than the states did in 1957. Their tools were found in the ACTION program, with enforcement getting the better portion of the credit. Replies from 25 mayors of cities with more than 200,000 population having the greatest reduction in deaths credited much of their success to better traffic supervision, particularly selective stepped-up enforcement. Flint, Michigan reported a 27% decrease resulting from tougher traffic policies and initiation of a teen-age traffic court and correctional clinics for adults.

St. Louis cut its toll by 22% after adopting a master traffic plan, which inaugurated one-way streets and improved off-street parking facilities. Civic, church, and city groups in St.

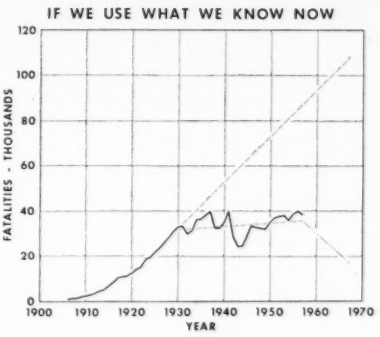


Figure 9

Louis promoted and stimulated safety education in schools and the community. Mayor Ziedler of Milwaukee, which had a drop of 43% from 1956, declared that reduction was achieved through excellent and far-reaching programming by the Milwaukee Safety Commission.

The governors of eleven states gave police activities major emphasis in the reduction of traffic fatalities in their states in 1957; they enumerated increased highway patrol forces, strengthened techniques, and stepped-up general enforcement.

Public education was mentioned by fifteen states as a primary factor in saving lives. Included under this category were safety education programs supported by the citizens, material and advice by the state safety departments and local schools and organizations, and driver education programs.

There are other areas in which substantial reduction in highway deaths could be made. Let us consider elimination of roadside obstacles. The National Safety Council's report for 1957[6] shows that 31% of the traffic fatalities for 1956 were non-collision accidents in most of which the car left the roadway. In nearly 16% of these cases the car overturned, and in nearly 15% it struck a fixed object. A systematic elimination of roadside obstacles and refinement of slopes and ditches would reduce this 31% — these 12,400 fatalities—to an almost negligible number.

Nearly 15% of the fatalities, 5960, occurred from head-on or sideswipe collisions of two vehicles going in opposite directions. On two-way roads and streets, 9% of the fatalities occurred at the intersections where both vehicles were going straight on the intersecting streets. All other maneuvers contributed only 4.5%. A substantial proportion of these intersection fatalities, and all head-on collision fatalities, would be eliminated if two-way travel were eliminated.

This would be impractical at times and inconvenient frequently, but it seems evident that there will be head-on collisions as long as vehicles travel in opposite directions on the same paved surface; it is equally evident that a certain proportion of these collisions will result in fatalities. The interpretation can only be that we are willing to put up with the hazards which result in more than 9,000 deaths annually, for the convenience of not having to drive around the block. Why? I suppose the answer is that each of us recognizes that he would be inconvenienced personally; the accidents will all happen to someone else, and hence are not a personal problem.

Substantial reductions in fatalities have always followed a significant increase in the level of enforcement. As an example, the number of fatalities was reduced more than 11% between 1955 and 1956 in Michigan; the Michigan package included more factors than improved enforcement, but there can be no question but what this was one of the most significant.

The success of the school driver training programs in reduction of accidents is recognized in preferential insurance premiums; there can be no doubt that increased application of these educational techniques, both for adolescents and for adults, would give a further substantial reduction. As early as 1937, DeSilva and Forbes[7] reported a follow-up study of 470 male accident repeaters, who were proved to have a 90% reduction in accidents during the following six months in comparison with a similar group who were given no tests or education.

The Accident Prevention Clinic of the New Jersey Division of Motor Vehicles was established in September, 1952.[8] The object was to reach the driver who had demonstrated a poor record by violations or accidents, and reclaim him if possible by thorough psycho-physical testing and remedial effort. Through June 30, 1957, 13,217 drivers had been processed. More than

4 Curtice, H. H. Speech before Citizen Leadership Conference, Midwestern Region, Chicago (April, 1958).

5 "Good Morning, Judge." *Traffic Safety* (May, 1958), p. 32.

6 National Safety Council, *Accident Facts*. Chicago (1957).

7 DeSilva, H. R., and T. W. Forbes, *Driver Test Results*. Boston: Harvard Traffic Bureau and W. P. A. of Massachusetts (1937).

8 Horner, Jack, "How New Jersey's Clinics Cure Problem Drivers." *Traffic Safety* (May, 1958).

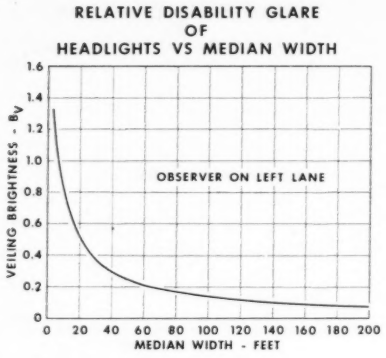


Figure 10

71% have had neither accident nor violation since processing; of the remaining 943 who have erred, the average yearly involvement in violations and accidents has been only 21% and 16% of the previous level.

The 1957 Wisconsin legislature has made it possible for Wisconsin courts to assign violators to bona fide courses in traffic safety, and seven Wisconsin cities now have traffic court schools in operation. Six other cities are now in the process of organizing schools. Governor Thompson has urged that such schools be established throughout the state, as they have shown that less than 5% of those who have attended have been arrested again for traffic violations.[9]

Greenshields[10] states that over one-third of the drivers answering a questionnaire are of the opinion that their driving skill cannot be improved at all (80% consider themselves good or excellent drivers), and that "It seems that if one is compelled to take refresher courses, he finds them beneficial. Maybe, driver retraining is more essential to safety than periodic vehicle inspection."

Application of speed zoning, when undertaken by qualified traffic engineers, has had a material effect in reducing accidents. While most of the emphasis on uniformity of traffic laws and regulations is expressed on a geographical basis, it seems evident that the uniformity should be on the basis of conditions rather than location.

The number of people killed at night exceeds those killed in daytime; in 1956, 55% of the fatalities occurred at night. However, the night fatality rates are consistently about three times the daytime rates. There can be no question that the fundamental difference is the absence of light, and it follows that improvement in lighting systems would have a substantial influence in reducing night-time fatalities. It is generally found that street lighting installations yield substantial reduction in accident rates.

Figure 10 shows the veiling disability glare experienced by a driver meeting oncoming traffic as a function of the median width of a divided highway.[11] This can leave no doubt that there is room for improvement both in current headlighting systems and in application of highway geometric design standards, both of which should produce better seeing and as a consequence, a substantial reduction in accidents.

We should consider the application of industrial safety practices to the highway field. A particular example is the General Motors Proving Ground, where, on a 4000-acre tract near Milford, Michigan, we have run cars on tests nearly 180 million miles during the past 34 years. There we have a private road system of about 62 miles of all types of surfaces, curvature, and gradients found in normal highway operation. We own the roads and the vehicles, and we can control the drivers much as the safety supervisor in a plant can control the practices of the employees in the plant. Our road system has no blind intersections, obstructed crossings, unmarked hills or turns, or other features likely to confuse the driver. By extensive experience on the relatively short road system, our drivers are familiar with every foot of roadway. Our road system is primarily one-way and access is controlled. In this respect, travelling conditions on much of the Proving Ground road system compare generally with turnpike or expressway driving; other portions compare with travelling on lonely rural highways in hilly, wooded country. Unfortunately, during the whole 34 years two fatal accidents have occurred, causing four deaths, which has established a fatality rate of approximately 2.3 per 100 million miles.

During the past nine years, our total accident rate is 460 per 100 million miles, which is less than a third of the national rate. Our personal injury accident rate is about 1/7 of the national rate. Our reportable accident rate (that is, reportable under Michigan standards) is 1/11 of the national rate.

Figure 11

We are by no means satisfied with this position, and we are currently doing everything we can to reduce the potential severity.

In a plant, the safety supervisor is responsible for the elimination of hazards before the accident occurs. By taking this viewpoint, we are systematically eliminating hazardous conditions, particularly roadside obstacles. Figure 11 shows what happened when one of our drivers went to sleep several years ago. Fortunately his injury was relatively slight. We have removed the tree because of its close proximity to the road, and we are removing other trees and obstacles so that the potential of serious or fatal accidents will be eliminated. Our road system was constructed according to the going standards of the time. As a result, we have conditions like this shown in Figure 12: deep ditches so close to the road that the slightest mishap traps the driver. In our roadside improvement program we will transform this condition into one shown in Figure 13, where the closest obstacle is approximately 100 feet from the edge of the pavement. We have raised our design standards recently and a section of road which we are building now has no obstacle within a hundred feet of the edge of the pavement on either

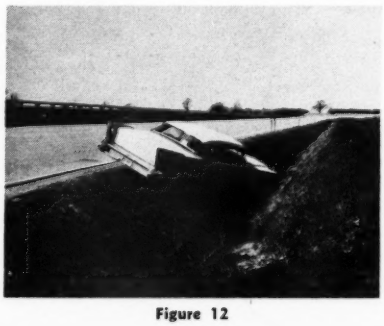


Figure 12

9 "Good Morning, Judge." *Traffic Safety* (May, 1958), p. 32.

10 Greenshields, Bruce D., "Effect of Emotions on Traffic Accidents." Paper presented at Michigan Safety Conference, Detroit (April, 1958).

11 *Annual Report of the Illuminating Engineering Research Council (1957).*

Figure 13

side. The maximum slope within this 100-foot roadside will be 6-to-1, and all ditches will have gently rounded bottoms.

Our accident record is as good as it is primarily because the road system is limited access and one-way. The Proving Ground drivers are selected with more care than drivers on the public highway, but they are by no means unusually highly skilled at the time of employment. We require a standard physical examination, including a vision test, and we determine by interview that they are reliable, responsible, competent individuals with at least normal driving ability. A most important factor is that our policing practices are self-enforced. We find that any individual violating the usual practices is quickly beaten down by the older drivers, who have their own way of converting their new associates. An accident at the Proving Ground has strong elements of social disgrace.

The industrial safety picture has been improved markedly by the intensive continuing programs conducted under the supervision of trained experts. One of the basic tools is the comprehensive reporting of every accident so that it is easily possible to determine the cause, and when the cause is found, to eliminate it. Much could be done, much could be gained, by similar precision in reporting highway accidents. Fortunately, this step is being taken by many jurisdictions, but the importance of making comprehensive, precise reporting universal, can hardly be overemphasized.

Only a few of the states require periodic vehicle inspection. Inspection station records offer ample evidence that a large proportion of vehicles on the road have mechanical defects. While it may be hard to appraise it, this is certainly a hazard potential which should not be ignored. Compulsory periodic inspection of at least the older vehicles is a must in any comprehensive safety program.

It is evident that there is room for improvement by known techniques. The answer to the question of "How are we applying what we know now?" is that we have made considerable progress, but we have a lot of knowledge we aren't using.

Figure 14 is an estimate of the reduction in fatalities from the number in 1956 which might be achieved by a substantial application of the factors which have just been discussed. I have listed the maximum percentage reduction as an ideal, and then selected some practical value that might be realized by a determined effort. I recognize that this is a controversial item; it is treated in this form to incite comment. You may not agree with my selection of "practical" values; you cannot disagree that this is food for thought.

Let us consider a few of the factors. The Detroit record suggests that effective local traffic organizations may reduce urban fatalities by 55%. The programs of such organizations include other factors, such as better enforcement, driver education or training, public information, public support, and other. Several other factors overlap. The Detroit record is good, but it is not perfect; therefore I am confident that a fully effective system of local organizations throughout the nation would reduce urban fatalities at least 40% below the 1956 level.

By the ideal treatment of roadsides, I am confident that fatalities from roadside hazards could be reduced 25%. Can we doubt that lighting could be improved to cut night fatalities by one-half?

You may not agree with my selection of "practical values;" if not, I invite you to make up your own table, consider it carefully, and decide whether a determined application of what we already know would not save tens of thousands of lives each year.

What Do We Need to Know?

A. *Vehicles*

The highway traffic problem, both as related to transportation and to safety, includes the vehicle, the roadway, and the driver.

Vehicle manufacturers would be the last to assert that there is no room for a sustained applied research of high level in vehicle development. There is no component of the vehicle which is not susceptible to improvement as better materials become available and manufacturing techniques are developed farther. The modern automobile is a safe, reliable, dependable vehicle but it will be improved year by year. Improvements in headlighting systems have been made with increasing frequency. The first general industry adaptation was the sealed-beam unit in 1940, followed by the improved sealed-beam unit in 1955, and by the dual lamp system which was generally adopted in 1957.

Several manufacturers are developing types of automatic controls for automobiles, and one has disclosed a system whereby a vehicle is steered by impulses from a cable buried in the pavement. It is too early to predict the outcome of these conceptions, but there is no reason now evident why guidance systems cannot be developed eventually to the extent that the path of the vehicle can be maintained without the driver's attention for long periods of time. This is thought of immediately as of great value in cross-country op-

	Maximum Possible Reduction %	Reduction Practical %	Practical Reduction (Number)
Effective Local Traffic Safety Organization	55	40	3800
Roadside Hazards	31	25	10000
Elimination of Two-Way Roads and Streets	24	15	6000
Enforcement	11	10	4000
Driver Education	—	20	8000
Speed Zoning	—	10	4000
Improved Lighting	66	50	11000
Industrial Safety Procedures	20	10	4000
			50800

Figure 14

erations, where the monotony of turnpike driving is believed to be responsible for loss of alertness and consequent accidents; with automatic guidance of the vehicle, accidents of this type would be reduced or even eliminated.

Every manufacturer is conducting an intensive development program on brakes, steering systems, transmisisons, suspension systems, controls, engines, cooling systems, and other components. The scope and intensity of vehicle research and development are at levels never before attempted, and you may be assured that the new cars will be even safer and more dependable.

Dr. Hafstad has suggested that certain driver information is required, such as whether he is driving at a safe speed for the particular section of highway under the specific road conditions that prevail, whether the speed is within the legal limit, whether there is gasoline enough to reach the next filling station, the immediate proximity of any cars approaching from the right or left rear, whether it is safe to pass the car ahead in the face of oncoming traffic, whether there is open road ahead of a closely bunched group of cars just in front, whether the driver is about to fall asleep, and how often the road is patrolled to provide aid in case of a breakdown. He said:

> "With my eyes on the road where they belong, my instruments tell me none of these things. Regarding some, I can get partial information with furtive, stolen glances. Regarding most, I get no information at all."

Here is a whole area of driver communications which justifies intensive research—we have no way of signalling driver intentions and speeds to other drivers.[12]

B. *Roadways*

Accelerated progress in roadway lighting is needed urgently. We have already suggested that continuous lighting systems, at least on the major portions of the network, are essential to the improvement in safety and flow of traffic at night. A great deal of practical information is required on the best types of lighting systems, the development of supports for luminaires which do not create the hazards of a roadside obstacle, and the development of lighting systems which will be effective in driving rain, blowing snow, and heavy fog.

The most effective operation of a traffic control system for a complex urban network is beyond the capacity of the traffic engineer in the absence of a theory to explain traffic flow. A committee of the Department of Traffic and Operations of the Highway Research Board is studying the theory of traffic flow; numerous individuals in industry, in the universities, and in the profession are developing mathematical techniques. Because of the complexity of the problem, a high-speed computer almost certainly will be required to make the system effective. Communication systems must be developed which will feed information into the computing center minute by minute. Experimental installations of television have been made so that the traffic engineer can observe the key spots continuously.[13] RCA demonstrated an installation at Lincoln, Nebraska last October[14] which can be used to signal the passage of a vehicle, and there are doubtless others, in being or in prospect, which will be applied effectively.

The potential economic advantage of increasing the effectiveness of a street system is tremendous. When we consider that the cost of a complex street system for a metropolitan area runs into the billions of dollars, it is evident that an improvement of only a few per cent in the efficiency of the system would be equivalent in value to many miles of additional freeways. This tremendous potential economy will demand increasing attention of our best mathematicians.

The rapid development of metropolitan areas makes it essential that area planning be undertaken and completed so that we may avoid the blighting of areas.

The Detroit Master Plan approved in 1950 divides Detroit into 155 neighborhoods of which 73 will be changed basically in land use and traffic patterns. The 155 neighborhoods are grouped into 16 planned communities, with 45 major outlying shopping centers planned for the future. A civic and convention center, a cultural center, and a medical center are provided. The expressway system is coordinated, and when present plans are completed, half of the residents of Detroit will be within 20 minutes drive of the central business district, the civic, cultural, and medical centers, and most of the city's industries.

Within twenty to thirty years, planners foresee a continuous interurbia extending from Maine to St. Louis, reaching as far north as Milwaukee and Bay City and as far south as Richmond and Lexington, Kentucky. Metropolitan area plans now established or in preparation must be coordinated on a regional basis to avoid unlimited confusion.

A matter of extreme significance from the safety standpoint is the development of the knowledge which will permit construction of highway surfaces with permanent skid resistance. A great deal of investigative work in the last few years has shown that many relatively new major highways have deteriorated under the polishing effect of traffic so that the surface may be dangerously slippery when wet.[15] A totally separate problem with the same results is that the accumulation of traffic slick and oil particles on the high-volume roadways yields a very slippery surface covering material with the first wetting down after a prolonged dry period.

The problem of polishing from traffic wear is of such major significance that the University of Virginia has called an International Skid Prevention Conference which will be held next September. The program will include experts on vehicle design, tire design, road design, pavement construction, and measurement of surface friction.

The objective of the conference is to bring together in one place everything which is known about the problem so that the gaps may be detected and steps undertaken to conduct the necessary additional research.

There are many research activities in progress. In the Highway Research Board, the Departments of Design and Traffic and Operations are most closely related to our subject. These departments have 23 project committees with memberships of from ten to twenty

12 Hafstad, L. R., "Research as Applied to Traffic Engineering." Paper presented at 27th Annual Meeting of the Institute of Traffic Engineers, Detroit (1957).

13 Malo, A. F., and Roy S. Head, "The Role of Television in Traffic Control." *Proceedings of the Highway Research Board*, Vol. 35 (1956).

14 Zworykin, V. K., L. E. Flory, and L. N. Ross, Electronic Control of Motor Vehicles on the Highway." Paper presented at 37th Annual Meeting of the Highway Research Board, Washington, D. C. (January, 1958).

15 Skeels, P. C., K. A. Stonex, and E. A. Finney, "Road Surface Friction from the Standpoint of Automotive and Highway Engineers." *Proceedings of the Association of Asphalt Paving Technologists*, Vol. 25 (1956). (Numerous other references might be made.)

people who are experts in their fields. There is a special committee on night visibility. The Institute of Traffic Engineers, the American Association of State Highway Officials, the Institute of Asphalt Paving Technologists, the Portland Cement Association, the Asphalt Institute, the Illuminating Engineering Research Council, and many other associations are conducting vigorous research in traffic and related problems.

Many of the universities have associated with them institutes of traffic and transportation. Notable among them are the ones of California, both at Berkeley and Los Angeles; Northwestern University; University of Michigan; the Bureau of Traffic at Yale and the Transportation and Highway Research Institute at Texas A & M. At Purdue University there is a joint research project with the Bureau of Public Roads, and at Michigan State University, a Highway Traffic Safety Center has been established recently. New York University has its Center for Safety Education, located in New York City. Thousands of engineers in the state highway departments, Bureau of Public Roads, the city traffic engineering offices, and the offices of consulting engineers are engaged daily in research in all aspects of traffic flow and road and street design.

C. *The Driver*

After we have applied what we already know and learned the many things we don't know now, there will still be highway accidents because of the occasional error of the driver. A most fruitful research would be to determine the accident causation factors in human behavior. This perhaps can be studied best by the methods of operations research. Many psychologists are studying the problem in all its complexities.[16]

I have in my files a memorandum from the Cornell Aeronautical Laboratory which suggests a method of making a mathematical analysis of the human being, just as the analytical approach is used in the design of aircraft.

It is well-known that the design of aircraft is so sophisticated that the operators place their orders years in advance for planes which are still on the drawing board, selecting between competitive models on the basis of minor variations in calculated performance. Airports are redesigned and expanded to meet the requirements of planes which are still in the design stage.

The performance of the great ocean liners, the *Queen Mary* and *Queen Elizabeth*, was computed so precisely that these vessels could be built in shipyards on rivers, where moving room and requirements on the way to the sea were computed to within a very few feet.

Early studies in this program suggest that the human being acts much as a servomechanism, and that it will be possible to describe human responses by the techniques of mathematical analysis. It is now recognized that the human is more like a very complex computor and a whole family of servomechanisms; it may be that part of the process of learning repetitive motion responses is simplification of the "computing" system and that the learning process is complete when the system made up of the fewest servos required for the task is established and used "automatically" when the stimulus is received.

The potential value of this research is almost beyond imagination. When the equations describing human behavior are established and the parameters dealing with specific situations can be set forth, it should be possible to design automobile control systems so that the best advantage will be taken of human properties. As an example of the peculiarities of the human being, this Cornell memorandum states that the reaction times range from .14 seconds to sound and .165 seconds to sight, to from 1 to 2 seconds for cases where interpretation and judgment are required (also see Reference No. 16). The reaction time on a lightly loaded aircraft control stick was given as .2 seconds, and for automobile brakes, as .6 seconds. The ability of the human to improve reaction time by learning is evidenced by the fact that most people can learn to play a musical instrument and participate as a member of a band or orchestra. Some can even play by ear. On the other hand, in an environment of unexpected or unpracticed situations, the response to the stimulus may take two or more seconds. Thus it seems clear that the driver can respond to familiar stimuli with almost no lost time, but there is a considerable lag in response to unusual or unfamiliar situations. Part of highway design criteria must be that ample warning be given of unusual situations or circumstances, and that the driver be confronted with the minimum number of simultaneous choices.

We might note that the developments of the equations of motion, or systems of equations of motion, of the human being will be of incalculable economic value in addition to the survival values; it will be possible to apply these equations to industrial situations so that more effective use will be made of human capabilities in productive work.

Logically, this analytical approach to human behavior can be undertaken best by scientists with a strong background in dynamics, just as the development of stability equations of aircraft has been conducted by these people.

On the other hand, we may look to the psychologists for the development of educational techniques which will impel our drivers toward the observance of well-established traffic practices, to shift the emphasis from enforcement of traffic regulations on somewhat rebellious drivers. Possibly the greatest hope for the final solution to the driver problem is the evolution of driver attitude from one of reluctant compliance with regulations to that of cooperative observance of the best traffic practices.

Summary

We have outlined many areas where active or future research in the problems of the vehicle, the highway, and the driver will produce valuable results in improvement of traffic mobility and safety. We have suggested, with Dr. Hafstad, that we already know more about the solution of traffic problems than we can persuade the public to accept. We have suggested that a determined application of existing knowledge and availability of funds could reduce traffic deaths to any negligible number we may choose and improve the mobility to any degree we may select. As automobile manufacturers, we recognize our responsibility in continued research and development work to improve the quality and safety of traffic flow; as highway and traffic engineers, to recognize and eliminate all hazards and restrictions to flow; as teachers, psy-

(Continued on page 23)

16 Forbes, T. W., and M. S. Katz, *Summary of Human Engineering Research Data and Principles related to Highway Design and Traffic Engineering Problems.* Pittsburgh: American Institute for Research (1957).

The Scope of Traffic Engineering in City Administration

By Russell E. McClure
City Manager, Corpus Christi, Texas
and Past President, International
City Manager's Association

It is good to have this opportunity to discuss the subject of the scope of the traffic engineering function in municipal government. I have had occasion to observe the continued growth in the significance of this important service since I entered the municipal management field in 1941. It was my responsibility in that year at Wichita, Kansas, to establish a traffic engineering division in our Public Works department. I obtained consulting service from Max Halsey to help me by analyzing our needs through a short survey and obtaining his recommendations regarding the scope of the responsibility of the traffic engineering division. His recommendations were also obtained as to the procedures to be followed in the recruitment of a traffic engineer. At this point I learned about the services of the Bureau of Highway Traffic at Yale University and was able to attract one of the recent graduates to our opportunity to establish our new traffic engineering division.

At that time a number of the functions were being handled by the police division. The effort was being made by traffic engineers to get their functions identified with the other engineering services of the city rather than as an enforcement activity. We were able to accomplish this at Wichita.

The scope of our traffic engineering there at that time was primarily in the field of traffic control. A citizens' traffic commission was established to work with the traffic engineer and to assist him in the public support phases. The work was largely the making of studies for the installation of traffic control signs, signals and markings. There was a small operations shop that handled the traffic signal instalalitons and maintenance and the street painting.

After Pearl Harbor, on December 7, 1941, the community began its rapid expansion with the growth of the aircraft industries there. This naturally meant a quick acceleration of the street traffic problem. Additional staff was obtained and new responsibiilties were added in such fields as parking control, the design of new streets, and the routing and designation of stops for the public transportation system. It was soon evident that the responsibilites of the traffic engineering unit would be continually expanded to meet the new problems that were continually arising in the movement of goods and people over the street system.

My next municipal management position was at Dayton, Ohio, in 1948. There, again, it was my responsibility to establish a traffic engineering division in the public works department. About the same process was involved in starting this new unit. The work there was one of modernizing the old street system. With the rivers running through the heart of the city additional bridges and the widening of existing structures were involved. Dayton is a compactly built city with a population of about 10,000 per square mile. This means an economy in many of the municipal services, however, it amplifies the traffic congestion problem. Public transportation there was provided largely by trolley busses with their large vehicles and fixed routing. It was necessary for the traffic engineering services to be geared to these additional responsibilities.

When I came to Corpus Christi in 1953 there was the desire here for the early establishment of a traffic engineering service. With the city's growth pattern it was evident that the street transportation system would require good advanced planning. Our central business district is in one corner of the city. With bays on three sides of the city our growth has been and will continue to be south and west of our central business area.

My most pressing assignment here was the preparation of a five-year capital improvement program which was submitted to the voters in November, 1953, and which resulted in the approval of approximately $22 million in bonds for streets, storm sewers, sewage treatment, water filtration and distribution, traffic control devices, and fire fighting facilities. We have been fortunate in having a very active, aggressive Area Development Committee that has worked closely with the various local governmental units in the planning and public support aspects of our public improvement program. As a result of the excellent cooperation that prevails among the various units of government here—the city, county, navigation district, school district, water district, state and federal—in addition to the city's bond projects for which the voters have approved approximately $36 million, the area projects total another $75 million, making about $110 million total. You can understand that this has required some very imaginative planning and a strong action program to accomplish these improvements in an area of this size with our city population at 175,000. There has been good public support for this aggressive permanent improvement program.

This paper was presented to the Texas Section at their semi-annual meeting June 21, 1958.

Our present department of traffic engineering was established in January, 1956, when we obtained Mr. Paul Rice to direct it. You will note that it has departmental status. It is my observation that this is the trend in many cities. In addition to the traffic control aspects we have added several new functions. One of the early ones was the street lighting system. In the parking control field we assigned our women parking meter attendants to the traffic engineering department. Expressway planning was recently assumed by the traffic engineer. One of his most recent assignments is the coordination of our staff activities in working with the central business area people to revitalize this section of our city.

It is evident that the scope of the responsibilities in the field of street transportation will continue to expand. With this expansion will come additional duties and responsibilities for the traffic engineer. The traffic engineer has the skills that are required to administer these significent functions in the municipal organization. There is a great opportunity and an impelling challenge in the period ahead for traffic engineers with well-rounded administrative experience who have a sense of good public relations. As all of you are aware this last aspect of public support is about as important as good, technical knowledge.

It has been my view for some time that all municipal activities affecting the entire field of transportation should be placed in one city department for its most effective administration. This would include street construction and street maintenance. It appears to me that there is an opportunity here for us to obtain more emphasis upon the use that is to be made of our street system by assigning this responsibility to a transportation department. In addition to the elements of good construction principles we should have more emphasis upon the carrying capacities of streets and other phases of traffic safety and movement that predominate the thinking of the administrator charged with the responsibility for an over-all transportation program. You are all aware of the recent developments in this field and it is carrying coals to Newcastle to discuss them with a group of this kind. The recent work that has been done by the National Committee on Urban Transportation is certainly outstanding. Your Institute of Traffic Engineers and our International City Managers' Association have been actively identified with the work of this committee. I hope that each of you is familiar with the publication by Public Administration Service this year of the report of that committee which is titled "Better Transportation for Your City." This publication, together with the various procedural manuals that are being prepared, are important additions to the literature of the traffic engineering field. I was also impressed with the recent reports of the management of the street transportation system in San Francisco which was prepared by the Automotive Safety Foundation in 1957. It offers some excellent suggestions for the organization of the street transportation functions in a large city that should be required reading for all traffic engineers.

These most recent studies point out the advantages of consolidating many of the functions that are now scattered in several departments into one department of street transportation for better coordination and more efficient administration of these services. The following suggestions for the organization structure point out the scope of the street transportation responsibilities as they are now being viewed:

1. TRANSPORTATION PLANNING—To provide research, data collection, planning and programming, this unit would formulate the master street transportation plan and translate it into a continuous program for street transportation improvements. This unit would also supervise the inventory and major record keeping showing the physical condition of the street system and all of the traffic and parking control devices.

2. STREET CONSTRUCTION — This unit would handle the design and construction activities including the establishment of standards and design criteria for street construction and the checking and approval of design work performed by outside agencies.

3. STREET OPERATIONS — This would include the functions of street use, traffic control and the operations shop. The street use unit would issue all permits for special street uses such as construction openings, driveways, sidewalk structures, parades, etc.

4. STREET MAINTENANCE — This would include the functions of street repair, structure repair, inspection, and street cleaning. Its responsibility would be the inspection of streets and sidewalks for hazardous structural defects and programming of maintenance work to correct defects and keep the street system in adequate repair.

5. ADMINISTRATIVE — This would include the general office activities with the proper accounting and cost records, a public transportation division to license and franchise public transportation enterprises and their effective regulation, and a public information office for the handling of requests and suggestions from the general public and obtaining prompt action on these matters. (I might add parenthetically that I believe a good public information office is one of the most essential needs in traffic engineering units at this time. This is particularly true when a new unit is first established as the volume of requests for service requires so much of the time of the professional staff that it would be wise to attempt to conserve that time by having a good person handle the public information activity.)

The increasing scope of the traffic engineering functions places an added responsibility upon the members of your profession to continually expand your knowledge of the entire field of street transportation. You have a responsibility to attract good people into your profession and to provide the proper training opportunities. Members of cities' governing bodies and city managers must realize the growing importance of this field of street transportation and provide every possible incentive and encouragement for those who are engaged in this field so that our cities will effectively meet our continually growing street transportation requirements.

RESEARCH APPLICATIONS

(Continued from page 21)

chologists, and public relations experts, that the most fruitful research is to determine why people do the things they do, and to coordinate our activities to teach them to do the things they ought to do. Great progress is being made in the solution of traffic problems; this progress can be accelerated to any rate we choose.

Mississippi's Pavement Surface Testing Program

By
A. M. White
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Traffic Control and Safety Engineer
and
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Mississippi Highway Department

THE MISSISSIPPI Highway Department, for the past three years, has been conducting a series of comprehensive pavement skid tests. Following chronic complaints that certain roads were excessively slick in wet weather, it was decided that some system of checking the skid-resistant properties of the various pavement types was needed.

It was known that several individuals and organizations in the past had conducted skid-resistance tests, and it had been found that skidding is controlled by both tire and pavement texture. Furthermore, it is influenced by other factors such as brake adjustment, crown of pavement, tire balance, and pavement irregularities. Taking these factors into consideration, a review of other organizations' studies was made in order to select a method which would give uniform and accurate results.

A study by Professor R. A. Moyer[1] of Iowa State College indicated that reliable results could be obtained by using what is commonly known as the "Stopping Distance Method." In brief, this involves locking the brakes of an automobile moving at a designated speed, measuring the skidding distance, and calculating the coefficient of friction. A similar study made by the Virginia Highway Department,[2] using this method, yielded close-checking results. The results of these two studies were deemed sufficient bases for selecting this method for use.

The equipment required in the tests included two new four-door sedans, electric detonator, water truck and measuring chain. The automobiles were 1954 Chevrolets equipped with standard 6-70 x 15 four-ply Firestone Deluxe Champion Super Balloon Tires. The electric detonator is of the type attached to the front bumper, firing a .22 chalk cartridge by actuation of the brake-stop light system. The pavement was wetted down by the use of an ordinary water wagon (See Figure 1).

The crew utilized consisted of six men plus two highway patrolmen who blocked off traffic during the test runs. The personnel needed included a driver, data recorder, detonator loader, water truck driver, and two men to make measurements.

As the coefficient of friction is usually high or satisfactory on most dry surfaces, emphasis was placed on a wet coefficient of friction. However, for purposes of comparison, both "wet" and "dry" tests were run.

In making a test run, the vehicle was driven at a speed of 40 MPH as it was believed that it would be unsafe to drive at a higher rate of speed on a wet surface. Upon reaching this speed, the driver would lock the brakes thereby firing a chalk cartridge on the pavement at the point where the skidding commenced. When the car braked to a stop, the distance from the chalk mark to the firing gun on the front bumper was measured, thus yielding the "skidding distance." This is illustrated by Figure 2 in which the driver has initially applied the brakes and in Figure 3, where he has braked to a stop and the measurement is being made. Also to be noted in Figure 2 is that the car was driven in the exact center or crown of the road. To obtain average results, three runs were made in as near as possible the exact location. The water truck was used to wet the surface prior to each run.

During the course of the initial study, approximately 2,000 skid measurements were made covering every type of surface in every section of the State. It was later calculated that the vehicles used actually skidded approximately thirty-three miles. At the first sign of tread wear, the tires were replaced with identical types. The constant locking of brakes necessitated frequent brakeband changes and eventually a mechanic was added to the crew for this purpose. The same driver was used throughout the series of tests.

The coefficient of friction was obtained from the formula $f = \frac{V^2}{30S}$ where V = the initial speed in miles per hour at the time of brake applications and S = stopping (skidding) distance in feet.

As results were analyzed, it was discovered that some types of surfaces were deficient in skid-resistance characteristics. A pre-determined criteria was set up to evaluate what constituted an excessively slick road. Moyer[3] found that for emergency braking conditions, a coefficient of from 0.40 to 0.60 was required. For the purpose of this program, a coefficient of 0.40 was selected as the minimum from a safety viewpoint. Surfaces found to have a factor of less than 0.40 were considered to be undesirable. The proper persons were notified of these sections and they were resurfaced to improve their skid-resistant characteristics.

The program received much attention from newspapers throughout the State and public reaction to the program was very favorable. Many persons complaining of certain slick sections of roadway had their complaints checked to their satisfaction. In view of this, the department felt that some type of permanent program would be of value, and plans were formulated for such.

1 R. A. Moyer, "Motor Vehicle Operating Costs, Road Roughness, and Slipperiness of Various Portland Cement Concrete Surfaces," *Proceedings*, Highway Research Board, Vol. 22, 1942, pp. 13-52.

2 Shelbourne, T. E. and R. L. Sheppe, "Skid Resistance Measurements of Virginia Pavements," Highway Research Board, Research Report No. 5-B, 1948.

3 Moyer, op.cit., pp. 13-52.

While the "Stopping Distance" method gave satisfactory results for the initial studies for a long-range and permanent program, it was believed that the use of some type of skid-tow trailer would be more desirable. The use of such a trailer would greatly reduce the manpower required and in addition, would not necessitate stopping traffic while test runs were being made. The department is currently constructing such a trailer patterned after that developed by General Motors. This type of vehicle will enable the coefficient to be read from a gauge with the tow trailer in motion pulled by a pick-up truck. Its simplicity of operation and mobility will enable tests to be made anywhere.

In evaluating the benefits received from this program, of course, the immediate one was that of detecting and correcting certain sections of highway considered to be unduly slick. Perhaps of more importance was the wealth of data accumulated to enable conclusions to be drawn and incorporated in future specifications for pavement surface design. The many variations and ramifications make it impossible to include them in this report, but they are to be published complete in a forthcoming Highway Research Board study.

The department feels that as a result of this program, many additional miles of road have been made safer, which is one of the prime functions of the traffic engineer.

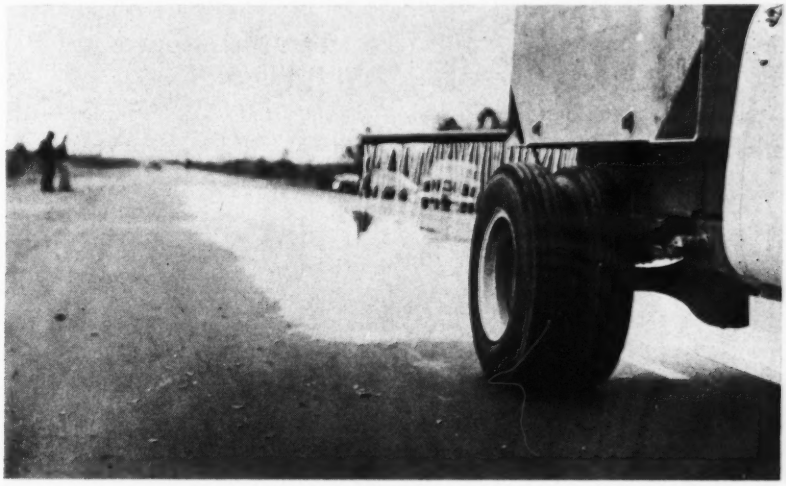

Figure 1

Figure 2

Figure 3

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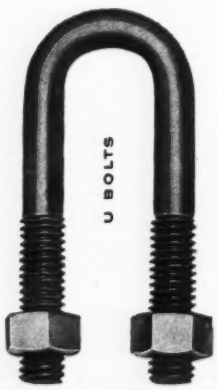

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Traffic News

MacDonald Memorial Fund Announced

A campaign to raise $1 million for a permanent memorial to the late Thomas H. MacDonald, for 34 years the nation's top highway administrator, was announced recently on the first anniversary of his death.

The Thomas H. MacDonald Memorial Fund committee said the money will be used to establish a Chair of Transportation at Texas A. & M. College.

After his retirement as United States Commissioner of Public Roads in 1953, "Chief" MacDonald, as he was known, began a transportation research program at the Texas institution which will be continued as a memorial to him.

Mr. MacDonald served the Federal Government under seven Presidents and 17 congresses. While his title changed from time to time, he retired in 1953 as Commissioner of the U.S. Bureau of Public Roads. He was elected an Honorary Member of the Institute of Traffic Engineers in 1943.

He is generally regarded as the man who contributed more than any other to bringing the nation out of the mud and to obtaining cooperative effort of Federal, state and local governments in creating the present national network of roads and streets.

The Memorial Chair provides for extension of the work Mr. MacDonald had been carrying on for four years at the Texas A. & M. Founded with Mr. MacDonald's counsel, the Institute has the purpose of providing leadership in the development of research and education in transportation.

The Chair is to be filled by a teacher selected for broad experience and for high qualities of wisdom and vision similar to those of Mr. MacDonald. Using Institute facilities, the work will cover all transportation fields, with the aim of providing benefits to public officials, industry and transportation users.

Sponsors of the Memorial Fund include leading Federal and state officials and engineers, members of Congress, industrialists and others who had associated with the "Chief" and respected his integrity and management abilities.

With headquarters in the Ring Building, Washington, D.C., the Organizing Committee is headed by Chairman Pyke Johnson, former President and now consultant to the Auutomotive Safety Foundation.

Chicago Transit Announces Research and Development Program

Organization of a $250,000 co-operative research and development program to step-up the progress of the high-speed era in urban transportation heralded by Chicago's new West Side Subway, has been announced by V. E. Gunlock, chairman of Chicago Transit Board.

America's first significant project to combine rail rapid transit with a grade-separated, multi-lane expressway (the Congress Expressway), the new subway is credited by transit experts with marking an epoch in urban area transportation.

Objectives of the research program are the development and testing of lightweight rapid transit trucks, gear drives, axles and auxiliary braking specially designed for high-performance operation of lightweight, all-metal rapid transit cars in the rights-of-way of multi-lane, grade-separated expressways.

High-crest speed of upward of 75 miles per hour, a longer period of acceleration at the fast rate of 3½ miles per hour per second, and enhanced passenger comfort and safety are the results expected.

CTA's associates in this latest of its pioneering ventures are the Transit Research Corporation of New York; the Westinghouse Electric Corporation of East Pittsburgh, Pa.; the General Electric Company of Erie, Pa., the Budd Company of Philadelphia, the General Steel Castings Corporation of Granite City, Ill., the St. Louis Car Company of St. Louis, Mo., the Dana Corporation of Toledo, Ohio, the Westinghouse Air Brake Company of Wilmerding, Pa., American Steel Foundries of Granite City, Ill., the Timken Roller Bearing Company of Canton, Ohio, and SKF Industries, Inc. of Philadelphia, Pa.

Five of the 100 rapid transit cars now being built for CTA by the St. Louis Car Company are to be equipped with the products of this research and development program. These five cars, each a single unit, double end car, will be test-operated as a train in the West Side Subway service, beginning next Spring or Summer.

Standards for Regulation of Outdoor Advertising

Secretary of Commerce Sinclair Weeks has announced that proposed national standards for the control and regulation of outdoor advertising signs in areas adjacent to the National System of Interstate and Defense Highways are to be published in the Federal Register and that interested persons will be given an opportunity to submit written comments and suggestions before final standards are adopted.

Under the provisions of the Federal-Aid Highway Act of 1958, the Federal share of the cost of projects on the Interstate System is increased by one-half of one per cent in those States which enter into an agreement with the Secretary of Commerce to control outdoor advertising adjacent to the Interstate System in accordance with national standards to be prepared and promulgated by the Secretary of Commerce.

Tentative national standards are now being reviewed and considered by the Department of Commerce. While there is no legal requirement that proposed standards be published in the Federal Register or that interested parties be given an opportunity to comment on them, the Secretary believes that the public interest will be better served by following this procedure.

low initial cost
low erection cost
lowest maintenance cost

Here's a new all-aluminum sign developed especially for the large signs required on major expressways. The "Increment Sheet Sign" consists of aluminum increment sheets hung vertically on a supporting frame. It can be made in any height or width, and for ground or overhead installation. Each sheet engages with the adjacent sheet, providing a smooth-faced sign panel.

The advantages are obvious; new lows in the cost of material, installation and maintenance. The aluminum never needs painting or other costly maintenance. Erection is quick and easy. Reflective materials or painted backgrounds are available in any type letters or symbols. As for strength, the sign above, on New Jersey's Garden State Parkway, is designed to withstand wind in excess of 100 m.p.h.

Send today for new pamphlet with full engineering data.

ONE RESPONSIBILITY TOO

Through our associate company, Pfaff & Kendall, Tassco can offer a complete range of standards and supports for ground signs and overhead spans to meet any requirement.

TASSCO

TRAFFIC & STREET SIGN COMPANY
84 Foundry Street, Newark 5, N. J.

Nashville Begins Comprehensive Study Of Transportation

The City of Nashville is the first city to undertake the comprehensive transportation study program as proposed in the new guide, *Better Transportation for Your City*, published by the National Committee on Urban Transportation. Participating in the study are the City of Nashville, Davidson County, Tennessee Department of Highways and Public Works and the U. S. Bureau of Public Roads.

The project, total cost of which is estimated at $450,000 will include an origin - destination study, comprehensive parking study, comprehensive mass transit studies, accident analysis, a physical street inventory including structures, roadways and control devices, traffic service studies to include studies of travel time, capacity and traffic volume, and a study of administration, laws, ordinances and financial accounting procedures as they relate to transportation.

A Technical Coordinating Committee has been organized to help guide the study. This committee is composed of representatives from various agencies responsible for transportation in the community. A prospectus outlining the project and responsibilities of the various participating agencies has been prepared.

Thomas B. Deen, (Jun. Mem., ITE), former traffic analyst for the Nashville Traffic Commission, has been appointed coordinator for the project.

Personnel

MacLachlan Retires From California Division of Highways

Kenneth A. MacLachlan (Mem., ITE) retired on May 1 after 28 years with the California Division of Highways.

MacLachlan was born in New Haven, Connecticut, and obtained his education in England and at the University of California, graduating with a B.S. degree in 1921. He served with the Navy in World War I and then with the U.S. Bureau of Public Roads.

Early in his state career MacLachlan was one of the group who formulated a definite highway signing policy as the first step toward California's present system of warning, regulatory, and directional signs.

Soon afterward he was assigned supervision over the California Highway Transportation Survey of 1934. He was instrumental in initiating the use of punch card equipment for tabulating and analyzing the vast amount of information produced by the survey. The Division of Highway's order for supplying and later processing 6,000,000 cards was the largest single order of its kind placed up to that time with the leading business machine concern involved.

In 1936 MacLachlan was given responsibility for organizing the California Highway Planning Survey, at that time under the direction of Maintenance Engineer T. H. Dennis. He continued as a member of the planning survey staff, now a part of the Planning Department, until his retirement.

Under his supervision the Division of Highways was the first agency of its kind to use punched card equipment to analyze highway accidents and detect problem locations; to use the coordinate system of analysis for traffic data; to depict the results of origin and destination surveys in the form of "trip desire line" contours; and to adapt gyroscopic equipment for highway survey purposes by means of a specially equipped vehicle.

MacLachlan is a member of the American Statistical Association in addition to the Institute of Traffic Engineers, and has served on several Highway Research Board committees.

Taylor Elected IES President

George J. Taylor of New York, vice president of Day-Brite Lighting, Inc., has been elected president of the Illuminating Engineering Society for a one-year term beginning October 1, 1958.

Mr. Taylor was elected to succeed Kirk M. Reid, senior illuminating engineer of the General Electric Co., Cleveland, in a mail ballot of the 9000-member organization composed of U.S. and Canadian lighting engineers, designers and related lighting specialists.

Among others elected to national offices of the society was Ray P. Teele (Affiliate, ITE), physicist in charge of photometry research for the U. S. Bureau of Standards, who was elected director for a three-year term.

Job Changes

William R. Crockett — from Wilbur Smith & Associates, Columbia, S.C., to U. S. Bureau of Public Roads, Washington, as Highway Research Engineer

Charles W. Koch—from City of San Francisco to Coverdale and Colpitts, Los Angeles, as Assistant Staff Engineer

Herbert A. Keegan — from City of Newark, N. J., to Paterson, N. J., as Traffic Engineer

Clark Elected President Mich. Safety Conference

Bayard A. Clark (Affil., ITE), assistant director of safety and traffic, Automobile Club of Michigan, has been elected president of the 29th annual Michigan Safety Conference.

With the theme, "Your Safety Tomorrow Is Our Job Today," the conference is expected to attract 5,000 safety-minded persons to Lansing's Civic Center next April 14-16. The meeting will feature safety sessions in nine different divisions including construction, government, industrial, office, public utilities, school and college, traffic, transportation and women's. It is one of the largest state safety conferences.

Edward L. Smith — from the National Safety Council, Chicago, to Waco, Texas, as district traffic engineer of the Texas Highway Department.

INSURANCE CHECK DELIVERED TO MRS. IRELAND

When Robert R. Ireland died suddenly a short time ago, he was insured in the ITE Life Insurance Plan. As a result, the Trustees of the Plan were able to turn over a check for $7,500 to Mrs. Ireland, who is shown above receiving the check from A. J. Basile, Traffic Engineer of the Kansas Highway Commission and president of the Missouri Valley Section of the Institute. At the right is Wm. J. Armstrong, Engineer of Plans and Traffic, Urban Roads Department, Kansas Highway Commission. Mrs. Ireland told Mr. Basile that she hoped the picture of the check presentation would serve to remind other members of the Institute of the value of the ITE insurance program and the importance of providing this sort of protection for their wives and families.

Strictly Business

Two Major Interstate Highway Sign Contracts Awarded to Tassco

The Traffic and Street Sign Company of Newark, New Jersey has announced the award of the first major highway sign contracts for the Interstate Highway System. They involve approximately 50 miles of roadway and are the "Charlotte By-Pass" and "Winston-Salem-Greensboro" sections of the North Carolina Interstate routes. These two contracts total 1176 signs and include advance exit guide signs, overhead guide signs, exit signs, regulatory signs and route markers.

The exit and guide signs have green reflectorized backgrounds and white border and legend of AGA Stimsonite material. All sign faces are manufactured in accordance with the newly adopted "Manual for Signing and Marking of the Interstate Highway System" published by the American Association of State Highway Officials.

Structurally, with the exception of the smaller type signs such as route markers, the entire signing program is based upon the new TASSCO sheet increment sign. The signs are entirely of aluminum and are made from standard four foot aluminum sheets. The sheets butt together on aluminum structural frames and are held by stainless steel hardware. The signs themselves are mounted on tapered aluminum supports supplied by Pfaff & Kendall of Newark, New Jersey.

There are 129 ground mounted increment signs ranging from 80 square feet to 250 square feet. These signs are mounted on tapered aluminum supports of the anchor base type. Each sign is mounted on two supports. The size of the tapered support is governed by the sign area.

Smaller signs totaling 243 units and averaging 30 square feet of sign area are ground mounted on single aluminum supports.

The overhead mounted signs are supported by 90-foot truss type box aluminum sign spans also supplied by Pfaff & Kendall. These overhead signs average 130 square feet each and three signs are usually mounted per span. The largest sign area for overhead use on one span is 486 square feet. There

Figure 1
Walter Schoenfeldt, General Manager, Traffic and Street Sign Company, checks a sign layout with plant personnel. ACA letters are mounted on the signs with rivets.

are 30 overhead signs to be mounted on nine spans.

The increment sheet signs as well as the tapered aluminum supports and spans are designed for wind loads of 100 MPH. Their basic construction of high strength aluminum and stainless steel hardware make them ideal for overworked maintenance departments, TASSCO believes.

The small signs including regulatory and marker signs total 774 units. These signs have miscellaneous mountings.

The first contract for the "Charlotte By-Pass" has already been completed and the roadway is open to traffic.

Figures 2 and 3
Sign section being assembled for checking purposes to assure proper fit and alignment before shipping. When shipped, sections are packed as 4-foot units and assembled in the field.

New Park-A-Loft Garage Opened in Parkersburg, W. Va.

A new mechanical parking garage was opened the end of July in Parkersburg, West Virginia, by the Parking Commission of the City of Parkersburg. The garage is reported to be the newest mechanical parking building in the country. It was designed and constructed by the Dresser-Ideco Company of Columbus, Ohio.

The big steel and aluminum structure, which is located on the southwest corner of Sixth and Avery Streets, is just a block and a half from the center of Parkersburg's downtown shopping district. It offers two features previously not found in mechanical garages anywhere in the country. The car handling dollies (which handle cars on and off the elevators) automatically adjust to the right length for the car being handled. This fully automatic length adjustment assures that the rubber covered lift-pads on the dollies are always positioned under the correct lift points beneath the frame of the car, regardless of its size, make or model.

Another unique feature of this mechanical garage is the wide open first floor area. Rails for the traveling tower-elevators are located on the second floor rather than at the ground floor level. This means that cars can be driven clear through the garage on the ground floor and don't have to be lifted or dollied across elevator pits or travelways. Consequently, the entire ground floor is fully usable for parking and maneuvering.

Fully loaded the new parking facility can handle a total of 264 cars with 48 parked on the ground level and 36 parked on each of the six upper levels.

The car parking mechanism in the Park-A-Loft consists of a pair of mobile towers, an elevator within each of those towers and a car handling dolly mounted on each elevator platform. Cars are picked up at the ground level by the dolly, smoothly moved onto the elevator platform. Then, as the entire wheel mounted tower travels on rails between the parking tiers, the elevator within the tower rises to the selected floor level. When the desired position is reached, the dolly rolls off the elevator into the empty stall and deposits the car. De-parking operations are just the reverse. The en-

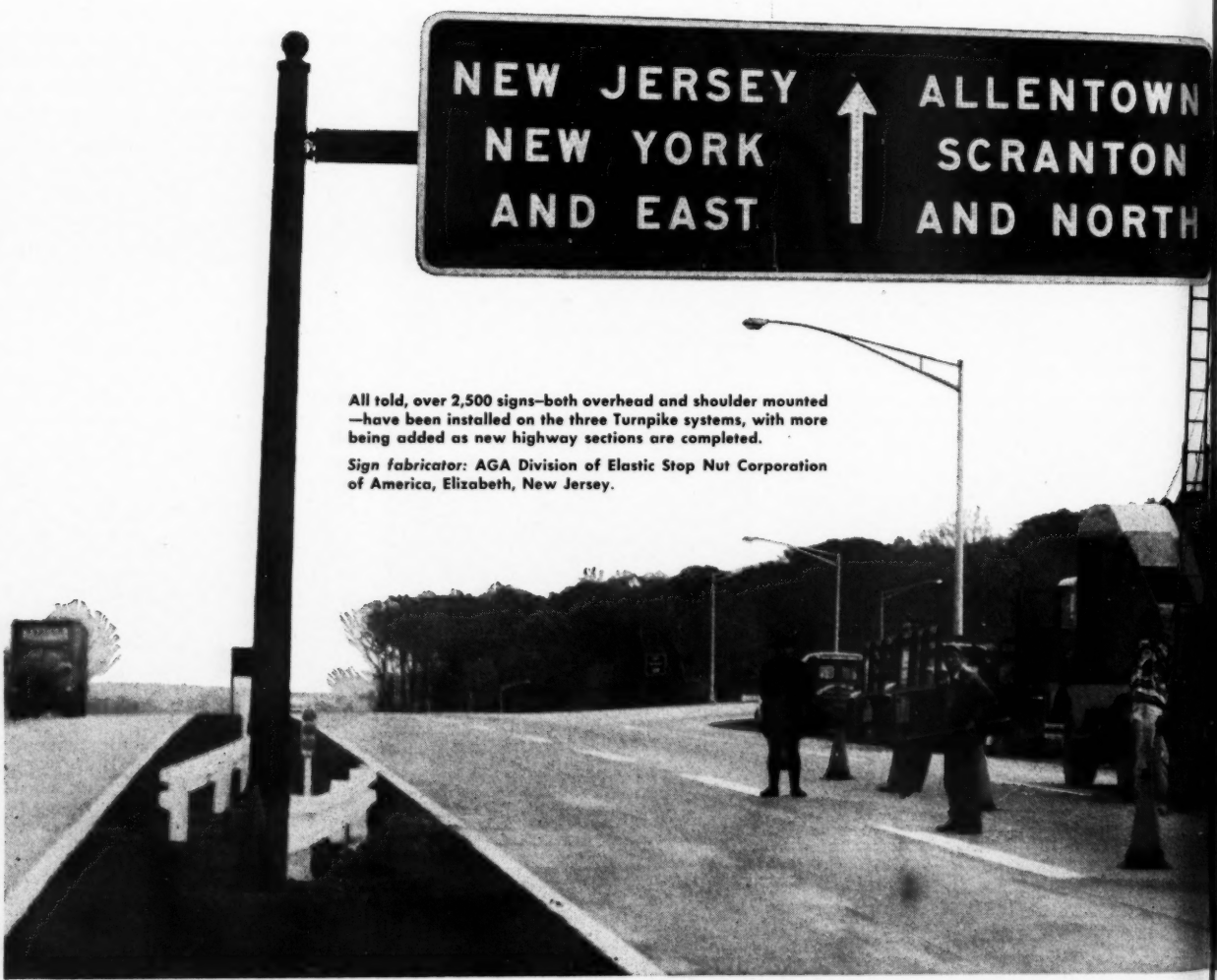
New Jersey Turnpike
New York State Thruway
Pennsylvania Turnpike

Overlaid plywood on the new

KING SIZE OVERLAID PLYWOOD SIGNS take the guesswork out of motoring along the new controlled access highways that speed traffic to and from the busy Eastern metropolitan areas.

Strategically located and reflectorized for nighttime legibility, these bright, easy-to-read signs make the New York Thruway and Pennsylvania and New Jersey Turnpikes a prime example of efficient highway signing. And because they cost less than signs of other materials—both initially and in long-term maintenance—overlaid plywood helps do this better signing job for less money.

Signs of overlaid plywood stand up better under severe weathering, deliberate or accidental abuse. Plywood's strength and stiffness simplifies framing. Standard panels can be easily cut or combined to make signs of any size or design. The durable plastic-like overlay prevents checking, provides an ideal base for paint or reflectorizing.



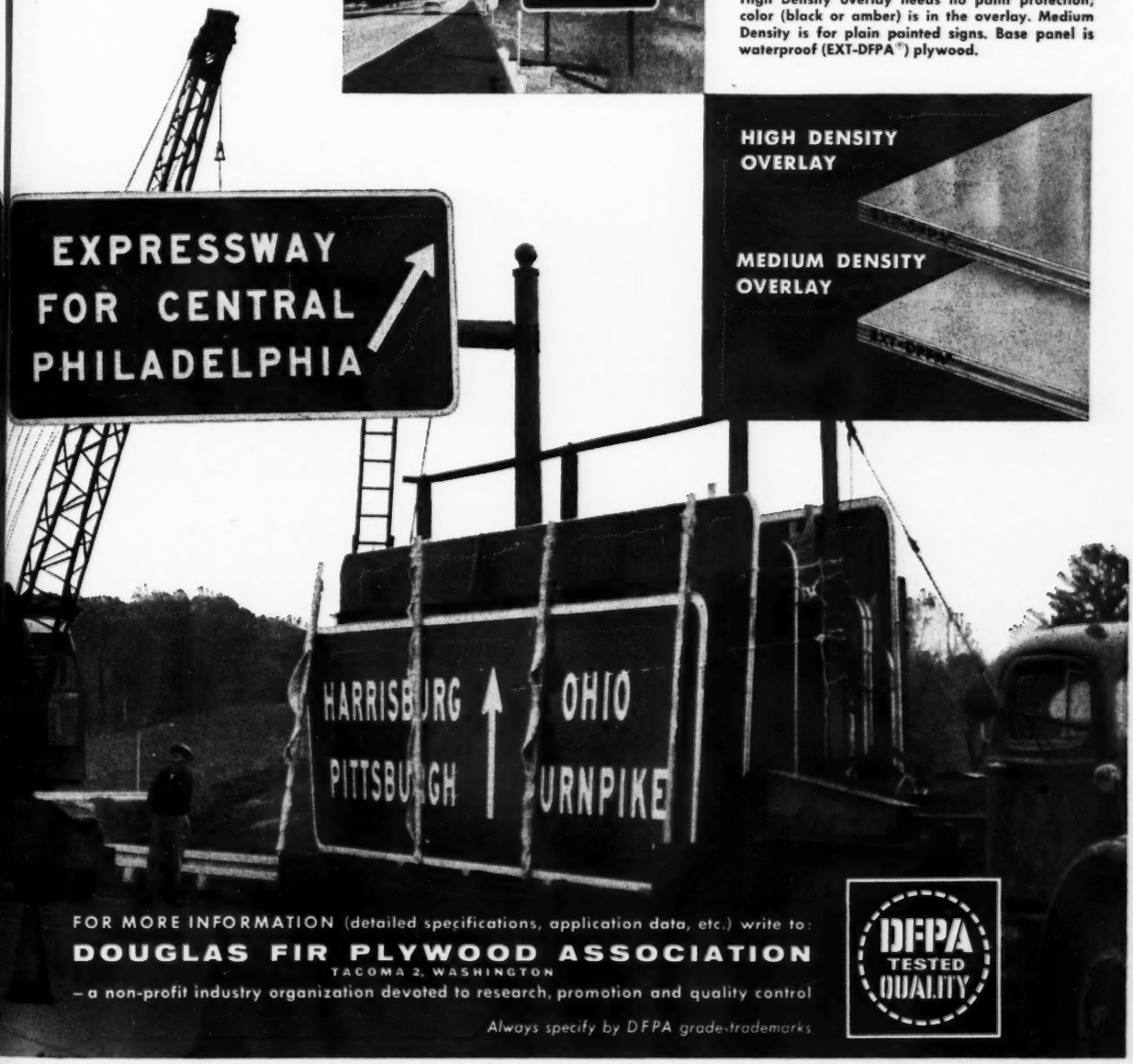
All told, over 2,500 signs—both overhead and shoulder mounted —have been installed on the three Turnpike systems, with more being added as new highway sections are completed.

Sign fabricator: **AGA Division of Elastic Stop Nut Corporation of America, Elizabeth, New Jersey.**

helps cut signing costs eastern turnpike systems

Overlaid plywood sign panels are stronger, more durable than metal. On shoulder mounted signs, fir plywood's greater stiffness means backing or supporting framework can be eliminated.

Durable overlay eliminates checking, grain raise. High Density overlay needs no paint protection; color (black or amber) is in the overlay. Medium Density is for plain painted signs. Base panel is waterproof (EXT-DFPA®) plywood.



FOR MORE INFORMATION (detailed specifications, application data, etc.) write to:

DOUGLAS FIR PLYWOOD ASSOCIATION

TACOMA 2, WASHINGTON

– a non-profit industry organization devoted to research, promotion and quality control

Always specify by DFPA grade-trademarks

DFPA TESTED QUALITY

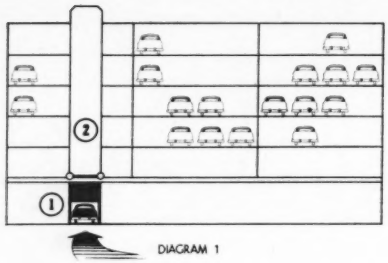


DIAGRAM 1

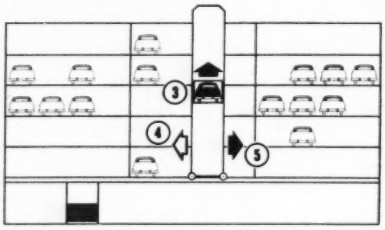


DIAGRAM 2

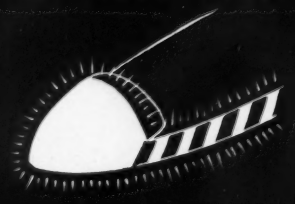
Diagram 1
Car pulls up to front of elevator (1). Elevator tower (2) is in position overhead and elevator is on ground floor. Dolly picks up car and carries it onto elevator.

Diagram 2
As elevator rises up into tower (3) the tower (mounted on wheels) begins to travel on rails along the face of the parking stalls in direction (5). It can also move in the other direction (4). As the tower travels, the elevator within the tower rises to the selected level. When the desired position is reached, the elevator and tower stop and the dolly carries the car into the parking stall and deposits it. De-parking operations are just the reverse.

YOUR Partner IN Safety

FLEX-O-LITE

Type H Safety Spheres



Tops in effective glass bead reflectivity—day or night. Easy to apply with ordinary traffic paint at just pennies per square foot. Full-time protection for utmost safety. Write for details.

FLEX-O-LITE MFG. CORP.
8301 Flex-O-Lite Drive
P.O. Box 3066 (Affton Br.), St. Louis 23, Mo

tire sequence of operations is controlled by an attendant who remains on the elevator at all times. Cars are not occupied during parking or de-parking operations.

The garage features wide, obstruction free entrances and exits and a comfortably furnished and air-conditioned waiting room.

Auxiliary power units have been installed to keep the garage's mechanical equipment operative at all times. The standby system includes two gasoline powered generators and auxiliary hydraulic motors. Hence, even in the event of complete failure from all outside power sources, the self sufficient garage can remain operative and continue to service its customers without interruption.

The Park - A - Loft garage is fully proven in service although the Parkersburg installation is the first open to the public. A full-size prototype has been operated for two years by Dresser-Ideco Company at its Columbus, Ohio plant.

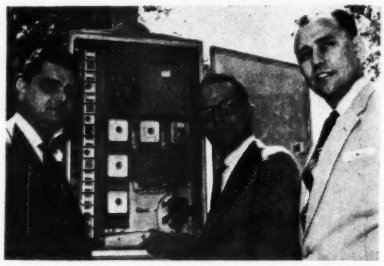
Eagle Introduces Traffic Control by Logic

An intersection in Cedar Rapids, Iowa is now equipped with a traffic control signal operated entirely by "Logic." This system, which has no moving parts in the entire basic system, was installed by Eagle Signal Corporation, based on designs by Eagle's Garland Fieser and G. Donald Hendricks. This initial installation has demonstrated that semi-actuated, full-actuated, or even three-phase-actuated systems of this type are entirely feasible.

Functionally, the Logic controller behaves at the intersection like a conventional electronic system. The entire system is static, however, from the magnetic detectors to the signal light indications. According to the manufacturer, the new system offers major advantages in lower maintenance costs and longer life as compared with the electronic type.

Logic elements are based on principles which have been known and used in various forms of static control for a number of years. The present elements, however, are a comparatively recent development, and the application to traffic is brand-new.

Logic elements perform the same functions in static systems that relays



Viewing the new LOGIC controller at the busy intersection of B Avenue N.E. and Center Point Road in Cedar Rapids, Iowa are (left to right) Robert M. L. Johnson, Commissioner of Public Safety, Cedar Rapids; G. Donald Hendricks, Design Engineer, Eagle Signal Corp.; P. R. Anderson, Eagle Sales Engineer.

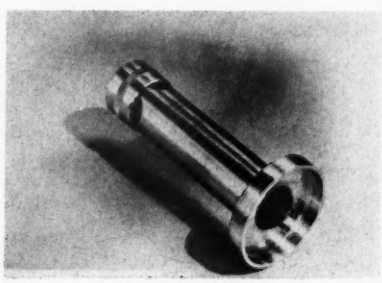
do in conventional systems. Relays convert a *single input* to a coil into various outputs by means of a moving armature which closes or opens contacts. Logic elements convert a combination of inputs into a *single output* by controlling the impedance of an output coil on a magnetic core. No moving parts are involved—nothing but cores, coils, germanium rectifiers, resistors and capacitors.

Fundamentally there are six types of Logic units—AND units, OR units, NOT units, MEMORY units, TIME DELAY units, and AMPLIFIER units. The units are used in combination to create the total circuit, which would otherwise consist of a number of relays.

For those technically minded, Eagle has some very interesting diagrams and charts which will help tell the story of these Logic units. Write Eagle Signal Corporation, Moline, Illinois, for this additional information.

Roth Offers New Photo-Electric Cell For Light Control

Roth Manufacturing Company, Chicago has developed a new floodlight control to automatically turn street lights, warning lights and other lights on when darkness approaches, regardless of the hour, and off when daylight comes or when illumination is not needed.



One of the new Roth Floodlight Controls #3158 can control 2,000 watts of fluorescent or neon lights, or 1,000 watts of incandescent lights. By using a power contactor it can control a bank of lights with an unlimited load. The three contact twist-lock plug in base makes it easy to install this new control on various types of light fixtures. Other types of bases with pigtail connections are also available.

The photo-electric cell in the control is easily adjusted to respond to various light levels between ½ and 100 foot candles of daylight by turning the screw down cap. The light-level scale on the side of the control makes it possible to set several controls in different areas to operate at a pre-determined light level.

The snap action mercury switch with tungsten to mercury contacts is hermetically sealed to eliminate pitting and corrosion, designed to give years of trouble free switching service. There are no vacuum tubes or other electronic parts or exposed contacts in the control. The four glass covered light-entrance ports in the aluminum metal housing are permanently sealed with compressed O-rings. The control can be installed at up to a 30 degree angle, can withstand considerable vibration and is not effected by temperature changes. For further information about this new Roth Floodlight Control #3158 write Roth Manufacturing Co., Dept. 178, 6420 West Howard Street, Chicago 31, Illinois.

Washington, D.C. To Install Radio Traffic Control System

Traffic signals in Washington, D. C. will be interconnected by the world's largest radio traffic control system.

The $167,000 award for an initial system for controlling signals at 87 intersections has been let to Motorola Communications & Electronics, Inc. by the District's commissioners upon recommendation of J. N. Robertson, Director of Highways and Traffic.

The centrally controlled radio traffic control system provides not only for the coordination and synchronization of traffic lights, but also for the automatic change of their cycles to meet demands of fluctuating traffic flow at various times of the day and week.

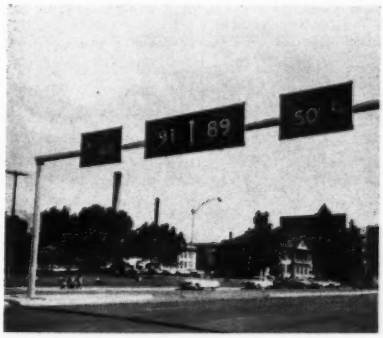
The use of radio rather than interconnecting cable will save District of Columbia public funds in excess of $2-million.

The new system will be programmed by a high-speed punched-tape device, the first to be used in a traffic control system. Complete standby central control facilities are to be included in the system.

As called for by the programmer, coded tone signals will be broadcast from the central radio transmitter. These will be received by radio receivers at each intersection, decoded and fed to standard traffic light controllers now present at each intersection.

The system is easily expandable to meet the future needs of the District with the ultimate capacity to control more than 1,000 intersections or groups of intersections. The equipment to be used is the most advanced of its type featuring transistorization, printed circuitry and modular plug-in construction.

The new system is expected to be in operation within a year.



Cameo Offers New Laminated Sign Panels

The permanence of porcelain enamel finish, the lightness of aluminum and the strength of honeycomb core have been successfully combined in the California Metal Enameling Company's new A-10 laminated sign panels, according to the company.

Ray Halverson, Traffic Engineer for the State of Utah, recently introduced the first over-head guide signs ever used in that state with the erection of several CAMEO A-10 signs, which were specified. In discussing the sales of these signs in other states, Hugh Penton, Vice President of CAMEO, said: "Because of the low initial installation cost and the minimum of maintenance required by porcelain enamel on aluminum, our new A-10 guide signs actually cost less than other types of signs without the permanence of porcelain enamel."

This isn't one of London's typically narrow streets, but it's nevertheless the site of London's first experiment with parking meters. The photo above was taken July 10th—the day that a vanguard of 648 parking meters went into operation for the first time in the British Isles, almost 23 years to the day that the parking meter collected its first coin in Oklahoma City. The meters surrounding Grosvenor Square (above) in the fashionable Mayfair district of London are Park-O-Meters, manufactured in Surrey, England, by Venner, Ltd., licensed to manufacture and sell in Europe by the Magee-Hale Park-O-Meter Company of Oklahoma City, originator of metered parking.

The signs in Utah are erected on Alcoa Aluminum Unitube supports. Background color is daylight green and letters, arrows and borders are AGA Stimsonite.

Among the advantages for this type of sign, the company cites the following: Lightweight aluminum makes for easier, faster handling during installation and every sign is engineered so that windload requirements are "built-in." Even the largest signs required can withstand over a 100 M.P.H. windload with a deflection of less than 1/100 of the span. The laminated porcelain enamel aluminum panels weigh only a pound and a half per square foot and are completely sealed against weather.

These panels may be drilled or cut with no fear of spoiling the porcelain enamel finish. Raw edges created by drilling will not rust because of the aluminum base . . . and if careless "marksmen" should damage a sign, the finish will not fracture and can be easily repaired with a CAMEO overlay disc. If replacements are needed for any reason, they will always match the color and finish of undamaged panels exactly because of the non-fading quality of genuine porcelain enamel by CAMEO.

Bound specification data and other technical material is available with no obligation from sales engineering personnel at CAMEO. Interested city and state officials are invited to write to California Metal Enameling Company, 6904 East Slauson, Los Angeles 22, California, for full specifications.

New Transistorized Highway Flasher Offers Increased Visibility

A new electronic highway hazard warning flasher, just introduced by R. E. Dietz Company, Syracuse, New York, and designed to afford maximum warning ability, is approximately 3 times brighter than any other flasher now on the market, according to the manufacturer.

The #604 Super Visi-Flash is double-faced and features two-way polished aluminum reflectors plus combination bulls-eye and wide-angle prism lens. It is claimed the resulting brilliance will alert motorists to highway hazards over 3500 yards in advance.

Designed for use by any organization requiring portable hazard warning lights, the #604 has an unbreakable 4″-diameter lens. The reflectors provide additional strength, and block out light coming from behind the flasher. Housing is black to increase light contrast.

The unit's transistorized circuit contributes to compactness and ruggedness of design, and permits a longer, trouble-free life. Transistors functioned satisfactorily after life-tests of over 18,000 working hours at full power — the equivalent in maximum load eight hours a day for six years. The transistors also operated at full ratings after withstanding the shock test of being fired from a mortar.

As opposed to neon vacuum tubes formerly used in electronic flashers, the transistors require only about 1/1000 the power and a small fraction of the space.

In performance tests conducted by the Dietz Company, the #604 operated dependably under extreme temperature ranges of 140°F. above zero to 40°F. below zero, and all extremes of moisture conditions.

The new flasher operates at 6 volts, using two standard electric lantern batteries with a life of at least 1500 hours. Flashing rate—preset at the factory—is 60 to 70 times per minute. Contributing to the flasher's high, attention-getting visibility is its longer dwell time (period of light) than other flashers, according to the Dietz Co.

The #604 Super is available with either red or amber lens. It is equipped with a field-tested tamper-proof bolt, available in 3 lengths for attachment to signs and barricades of different thicknesses.

Additional information on the Dietz #604 Visi-Flash is available by writing to Portable and Hazard Lighting Division, R. E. Dietz Company, 225 Wilkinson Street, Syracuse, New York.

New Publications

The AASHO Manual for Signing and Pavement Marking of the National System of Interstate And Defense Highways

American Association of State Highway Officials, National Press Bldg., Washington, D. C. 1958. 60 pp. $2.00.

The long-awaited manual for signing and marking of the Interstate System has been issued by the American Association of State Highway Officials. This is the printed version of the draft adopted February 10, 1958 by AASHO and approved February 21, 1958 by the Bureau of Public Roads.

This manual is the official guide to signs which may be erected within the rights of way of the Interstate System. Included are signs for interchanges, route markers, regulatory and warning signs, special signs for rest areas and for services, mileposts, and sections dealing with sign structures, pavement marking, delineators, and miscellaneous sign details. An introductory section discusses warrants for overhead signs, sign lettering and spacing, borders, color, reflectorization, illumination, messages and arrows, and sign clearances.

Included are thirty-two pages of drawings of signs and sign layouts at typical highway situations. Also included are large color chips to show the standard red, yellow, green and blue shades specified for the Interstate signs.

Parking Industry Operating Cost Survey

National Parking Association, Sheraton Building, Washington, D. C. 1958. Mimeo (with processed tables). $10.

More than 40 cents out of every dollar Americans pay to park the family car in off-street parking lots goes toward rental of the real estate.

Of the remainder, more than 12 cents is spent by the parking operator for operating expenses, nearly three cents is set aside for taxes, and more than two cents for depreciation and amortization, leaving only about 42 cents for all salaries and wages.

These and other statistics about the automobile parking industry have been tabulated in a special survey by the National Parking Association. Data for the survey was collected in confidence from association members throughout the nation and analyzed by William Gordon Buchanan and Company, Washington, D. C. accounting firm.

The survey includes information as to how operating expenses differ between lots and garages, how labor costs in self-service parking facilities compare with those of attendant-parked operations, and how much of the parking operator's gross income should be paid for salaries and wages. Information in the survey has been tabulated by regions, making it possible to compare operations with those of a similar nature.

Manual of Accident Prevention In Construction

Associated General Contractors of America, Washington, D. C. 1958. Looseleaf.

This looseleaf manual includes sections on all types of construction. The most interesting one from the standpoint of the traffic or highway engineer is the section (Section 20) on Highway and Street Construction. This 34-page section has been completely rewritten, following many of the suggestions developed in Georgia by the Construction Section of the National Safety Council. A local committee in Washington, composed of several ITE members, reviewed the section and made a number of suggestions.

Specific sections include: traffic signs, lighting and marking devices, barricades and fences, flagmen, signals, application of signs and devices, detours, urban construction, and location of traffic control devices.

SIGNAL VOLUME WARRANTS

(Continued from page 10)

After having determined the size gap that was normally required for side street entrance into a major street, and determining the availability of gaps of the required length in major traffic streams under various volume conditions, the process of correlating these two factors required the establishment of the proportionality between the two factors at which signalization of the intersection would be warranted. It was felt that the gap availability versus gap requirement ratios that exist at the approach volume levels of the existing signal warrants should be used as a basis for this proportion, and that the proportion thus established could be extended to cover all practical approach volume conditions.

In the first phase of the analysis, it was found that the gap requirement for movement into a two lane highway is six seconds and for movement into a four lane highway, the average gap requirement is nine seconds. To meet the existing minimum volume warrants for signalization of a rural intersection, the principal street (two lane) must contain 375 vehicles per hour, if the total intersection volume is to be 500 vehicles per hour with 125 of these on a side street. Reference to Figure 1 indicates that in a two lane stream of 375 vehicles per hour, there are approximately 172 gaps per hour of six seconds or greater duration. Therefore, it follows that 175 suitable size gaps per hour are available for the 125 vehicles on the side street, or 1.4 gaps per side street vehicle, for the volume conditions under which a signal may be considered as warranted. It may be rationalized therefore, that under these warrants, a signal will be justified for any reasonable side and two lane main street volume conditions where less than 1.4 gaps of six seconds or more are provided for each side street vehicle. Similar factors for other warrants for two lane highways are as follows:

Minimum Veh. Vol. Warrants	Tot. Intersect Vol.	Side Street Vol.	Main St. Gaps Per Side St. Veh.
Urban	750	250	1.4
Rural	500	125	0.7
Interruption of Cont. Traffic Warrants	Tot. Intersect Vol.	Side Street Vol.	Main St. Gaps Per Side St. Veh.
Urban	825	75	3.5
Rural	550	50	2.4

Since these factors indicate only the degree of hardship that is felt to be not unreasonable for side street vehicles (by virtue of the shortage or abundance of suitable size gaps available for their movement without signalization), these factors should also be applicable for four lane facilities. It should be remembered, however, that a nine second gap on the average four lane highway is required for side street movement, rather than the six second gap which is required for the average two lane facilities. The curves shown in Figure 2 indicate the values of side street and total intersection volume that produce the ratios of 1.4 and 0.7 gaps of a suitable size per side street vehicle for two and four lane rural and urban highways respectively, under the Minimum Vehicular Volume Warrants. The curves in Figure 3 indicate the various side-main street volume ratios that warrant signalization under the Interruption of Continuous Traffic Warrants. In both warrant categories, it will be noted that for identical main street volumes in similar area types, fewer side street vehicles are required to meet the four lane warrant than are required for the two lane warrants. This phenomena is somewhat unexpected, since under equal volumes the four lane facility would normally be expected to present more and longer gaps than would a two lane facility. Even though this increase in the number of gaps probably does occur, the requirement of longer gaps for movement into a four lane facility, than for moving into a two lane facility, no doubt causes the phenomena.

Figures 4 and 5 indicate the effect of median treatment on the main street on Interruption of Continuous Traffic and Minimum Volume Warrants. The top limit of the shaded band shown for both four lane rural and urban facilities is applicable at locations where the main highway has adequate median treatment to shadow side street movement, where only an 8 second gap is required for side street movement. The bottom limit of these shaded areas applies to locations where the median treatment is not sufficiently wide to shadow side street movements, where a a ten second gap is required for side street movement. As would be expected, the general tendency of median adequacy is to produce greater intersection capacity, hence higher side street volume requirements for meeting signalization warrants.

Due to the ever present limitations on the time, funds and personnel available for such projects as this, the scope of this work has of necessity been somewhat limited. The accuracy of the work that has been done, however, is felt to have been unaffected by these limitations. It may rightly be considered doubtful in some cases, however,

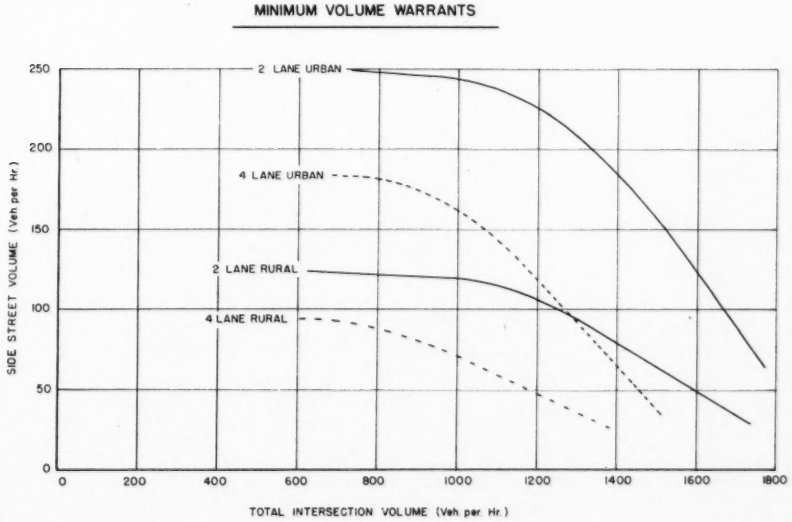


FIGURE 2

if this work is of a broad enough aspect to allow all inclusive application. If, for example, the complexities of cross flow side street traffic are of major significance, it is doubtful if this work in its present form will suffice. Also, in this work, it has been necessary to study facilities that represent a compromise between rural and urban areas, rather than to study each type separately. Should this distinction be proven necessary for any particular intersection, the study should be supplemented to include these differences. Similarly, any other intersection peculiarities, such as abnormal turning movements, sight distance restriction, and restrictive grades that may serve to make the intersection anything other than *average*, may prohibit the use of this work in its present form. If, however, an intersection may be classed as average, as defined previously, it is felt that the information derived in this project can be used with confidence.

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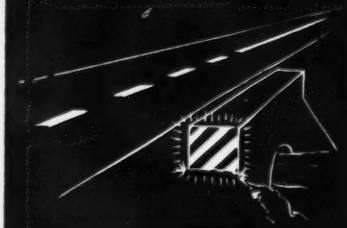

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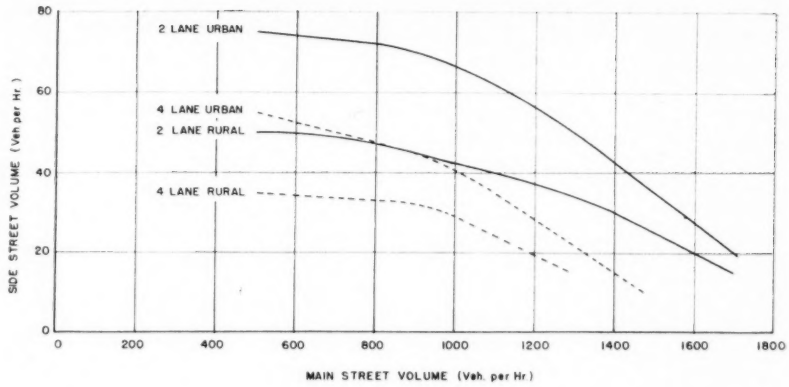


FIGURE 3

EFFECT OF MEDIAN TREATMENT
ON
INTERRUPTION WARRANTS

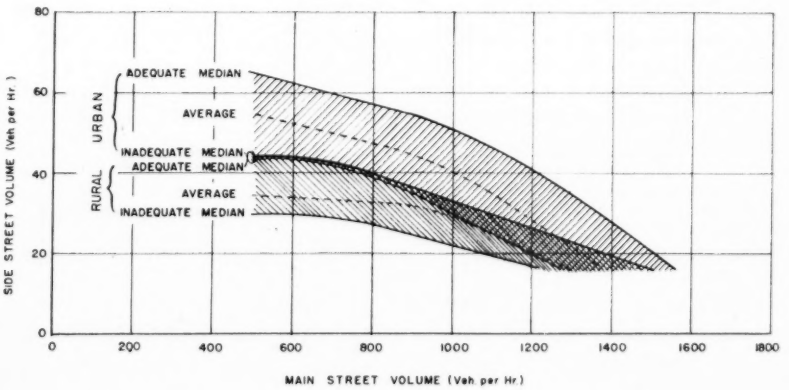


FIGURE 4

EFFECT OF MEDIAN TREATMENT
ON
MINIMUM VOLUME WARRANTS

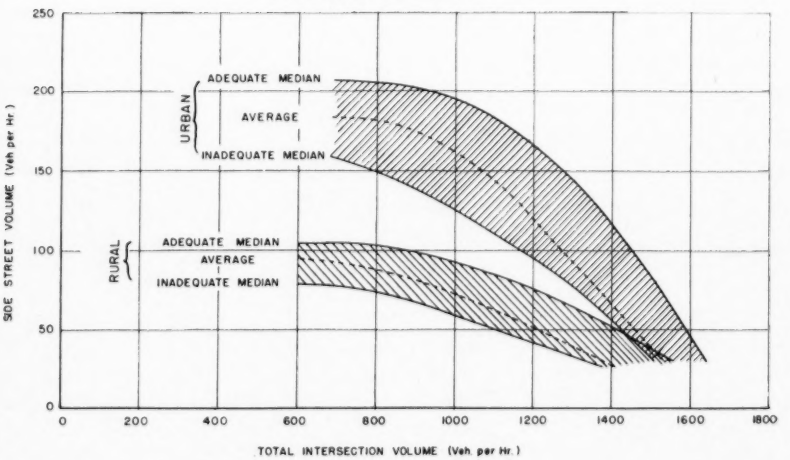


FIGURE 5

Section News

INDIANA, MICHIGAN AND OHIO SECTIONS

District 3 is planning their annual get-together at Pokagon State Park (north of Angola, Indiana) on September 19, 20 and 21. This is a combined business and social affair, with all members residing in District 3 and their wives invited. *Special notice to Ontario:* You are in District 3 and are cordially invited to come.

METROPOLITAN (N.Y.) SECTION

News

Gordon Gravelle, Deputy Commissioner, New York City Department of Traffic has been elected to Honorary Membership in Chi Epsilon, the National Honorary Civil Engineering Fraternity by the Chapter at the Polytechnic Institute of Brooklyn.

Bruce Gramling, has returned to the New York City Department of Traffic after a year at the Yale Bureau. Bruce has been appointed Assistant Director of the Intersection Control Division.

Two other members of the New York City Traffic Department, *John Kaiser,* Chief, Survey Section, Intersection Control Division and *Edward Bonelli,* Chief, Survey Section, Division of Traffic Services will attend the Yale Bureau during the 1958-59 year.

Edmund Cantilli, has been promoted from Traffic Engineer I in the Traffic Engineering Division of the Operations Service Department of the Port Authority, to Highway Project Planner in the Planning Division of the Port Development Department.

May was a big month for *Alan Gonseth,* Planning Technician in the Port Development Division at the Port Authority. He was accepted at the Yale Bureau for the 1958-59 year and closed out the month gloriously with his marriage to Maureen Hanney of Douglaston on Memorial Day. They spent their honeymoon in Miami.

Kenneth Crowley, Assistant Highway Planning Engineer in the Port Authority's Port Development Planning Division will attend a two-week course in Computer Methods for Highway and Traffic Engineers from July 7 to 19 at the Yale Bureau. The course is sponsored jointly by the Bureau and the University of California Institute of Transportation and Traffic Engineering.

WESTERN SECTION

San Diego Area News

San Diego was well represented at the Sacramento meeting in the persons of *Steve George, Ed Hall, Chuck Strong, Lucky Luckenbach, Paul Fowler, Jim Reading* and *Marty Bouman.* After two weeks, all seven are just beginning to get their color back.

Ed Hall reports completion of the San Diego Pilot City Study as of June 30. For sale cheap: One slightly cloudy Crystal Ball.

The City of San Diego plans to install a number of temporary traffic signals (old trolley poles and overhead wiring) during the coming fiscal year. Traffic Engineer *Jim Reading* and Signal Engineer *Hal Durham* have lead the battle to signalize these locations which would otherwise not be considered because of future major improvements.

County Traffic Engineer *Paul Fowler* has completed signalization of Broadway and Imperial in Lemon Grove. The installation is complete with radar detectors, 12" lenses, aluminum poles and arms, lighted push buttons and half-lit pedestrians. A unique installation, and the first of its kind for San Diego County.

Oregon Area News

Personnel in the Traffic Control Section recently completed a report on the Truck Turning Path Study. Field operations were conducted last fall utilizing trucks with lengths ranging from 50 to 60 feet. The report shows the turning paths for various turning radii and central angles. Copies are available upon request from the Traffic Engineering Division, Oregon State Highway Department, Salem, Oregon.

The installation of the traffic signal system on the new one-way couplet in Grants Pass was recently completed. Contracts for construction work and signal installations on the Main-Eighth Street one-way couplet in Medford have been let. Telephone channel will be employed for inter-connect purposes in Medford.

Professor *Martin P. Coopey* of the Civil Engineering Department at Oregon State College is working for the Oregon State Highway Department this summer supervising the gathering of field data on miscellaneous planning survey projects. The first work assignment will be conducting field interviews for Origin-Destination Studies in Southern Oregon along the route of US-99 looking to traffic assignment to Interstate Route 5. Later in the summer he will work with truck weight and special loadometer studies. We wonder if this will be much of a vacation for Professor Coopey, for the crew will be composed of Engineer Trainees who have taken one or two years at Oregon State College. It probably will be as much of a vacation for him as it will the crew.

An Oregon Area Dinner-Business Meeting was held at the Ione-Plaza Apartments in Portland the evening of June 6th. The attendance totaled 21 with an almost equal distribution between the State Highway Department from Salem and the Portland and Multnomah County Traffic Departments from Portland. It was the last meeting presided over by Co-Chairmen *Val Johnson* and *Howard Huget.* Newly elected Co-Chairmen were *Glen Clark* from Salem and *Dick Speer* from Portland. A short clinic on the methods of obtaining correct peak-hour volume counts was conducted by *Don Bergstrom,* and a lively discussion was held on directional signing. Following the meeting, all members present under 30 adjourned to the Roosevelt Hotel to watch a stripping, —'er striping demonstration.

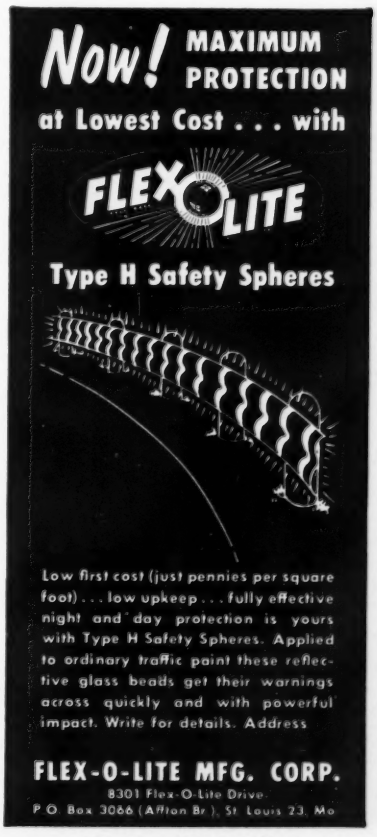
Training Opportunities

September 24-26 — FREEWAY OPERATIONS SEMINAR —
The third in the current series will be held at the Northampton Hotel, Northampton, Massachusetts, under the sponsorship of the New England Section of the Institute of Traffic Engineers. Traffic engineers, design and planning engineers, police traffic supervisors and others with responsibility for present or future operation of controlled access facilities in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York (upstate), Quebec and Ontario are invited. For reservation forms and additional information, contact Roger T. Chandler, City Traffic Engineer, 147 Fountain Street, Providence 3, Rhode Island, or ITE, 2029 K Street N.W., Washington 6, D.C.

October 6-8—FREEWAY OPERATIONS SEMINAR
The fourth in the current series will be held at the Holiday Inn motel west of Harrisburg on the Pennsylvania Turnpike (at U.S. 15) under the sponsorship of the Mid-Atlantic Section of the Institute of Traffic Engineers. Traffic engineers, design and planning engineers, traffic police supervisors and others with responsibility now or in the future for operation of controlled access facilities in Pennsylvania, New Jersey, Delaware, Maryland, District of Columbia, New York (western part), Virginia and Ontario are invited. For reservation forms and additional information, contact Paul D. Muffley, Highway Planning Engineer, Pennsylvania Department of Highways, 21st & Herr Streets, Harrisburg, Pa., or ITE, 2029 K Street N.W., Washington 6, D. C.

October 29-30 — COMPUTER APPLICATIONS SYMPOSIUM—
The Fifth Annual Computer Applications Symposium, sponsored by Armour Research Foundation, will be held in Chicago October 20 & 30. For information, write: Armour Research Foundation of Illinois Institute of Technology, 10 West 35th Street, Chicago 16, Illinois.

March 2-20, 1959 — TRAFFIC ENGINEERING SEMINAR—
Presented by the Northwestern University Traffic Institute in cooperation with the Midwest Section of the ITE. Designed for city and state traffic engineers and others with engineering backgrounds who work in areas closely related to traffic engineering. Instruction by practicing engineers, supplemented by specially written monographs. Tuition $195.00. For further information, contact Director of Training, NUTI, 1804 Hinman Avenue, Evanston, Illinois.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Reference Notes

Pre-Timed, Fixed Cycle, Traffic Signal Controllers

This is a revision of Technical Bulletin No. 2 of the Institute, approved as an American Standard on October 14, 1943. The revision was developed by Technical Committee 7-A, and was approved as an Institute Standard by the Board of Direction on May 23, 1958. It is being submitted to ASA for approval as a revised standard.

PURPOSE

The purpose of this standard is to set up purchase specifications for pre-timed, fixed cycle traffic signal controllers.

A. DEFINITIONS

1. *Controller.* A complete electrical mechanism for controlling the operation of traffic control signals, including the timer and all necessary auxiliary apparatus mounted in a cabinet.

2. *Automatic Controller.* A self-operated controller for operating traffic control signals automatically.

3. *Manual Controller.* A controller for operating traffic control signals by hand.

4. *Pre-Timed Controller.* An automatic controller for supervising the operation of traffic control signals in accordance with a predetermined, fixed time cycle and divisions therof.

5. *Manual Operation.* The operation of an automatic controller by means of a manual switch.

6. *Manual Switch.* An auxiliary device for manual operation of an automatic controller.

7. *Auxiliary Manual Controller.* A separate and distinct manual controller attached to an automatic controller by means of which the traffic control signals may be operated by hand when the automatic timer is removed.

8. *Timer.* An automatic timing unit in a controller including all dials, switching and flashing mechanism, circuit contacts, motors, gears, camshaft, etc.

9. *Master Controller.* An automatic controller for supervising a system of secondary controllers, maintaining definite time inter-relationship, and/or accomplishing other supervisory functions.

10. *Secondary Controller.* An automatic controller for operating the traffic control signals at an intersection under the supervision of a master controller.

11. *Local Controller.* A controller for operating traffic control signals at an intersection (or two or three proximate intersections) which may be isolated or included in a non-interconnected traffic control signal system.

12. *Combined Master and Secondary Controller.* A secondary controller equipped with auxiliary contacts for checking the offset and, when specified, means for accomplishing other supervisory functions over all secondary controllers in the system.

13. *Alternative Sequence Controller.* A controller designed to provide a selection of either of two interval sequences, one of which might include pedestrian and pedestrian clearance intervals.

14. *Pedestrian Actuated Controller.* An automatic controller in which part of the intervals or groups of intervals, particularly pedestrian WALK and clearance intervals, are initiated by actuation of a pedestrian detector.

15. *Synchronous Controller.* An automatic controller operated by a synchronous motor which will keep in step with the frequency of the power supply circuit.

16. *Non-Interconnected Synchronous Controller.* A synchronous motor-driven controller not equipped with remote reset contacts or other provision for future interconnection, but capable of maintaining a definite time relationship with other non-interconnected synchronous controllers.

17. *Future Interconnected Synchronous Controller.* A synchronous motor-driven controller designed to operate temporarily as a non-interconnected controller but equipped with automatic reset contacts and jacks or other means for the future insertion of relays for remote control of traffic control signal shutdown, flashing indications, and other operating features which may be specified so that the controller may be interconnected at some future time.

18. *Interconnected Synchronous Controller.* A synchronous motor-driven controller designed for immediate interconnected operation supervised by a master controller equipped with automatic reset contacts, jacks and relays or other means for remote control of traffic control signal shutdown, flashing indications, and other operating features which may be specified.

19. *Synchronous Supervisory Mechanism.* An auxiliary synchronous device applied to an induction motor-driven controller or semi-actuated controller to cause such controller to keep in step with the frequency of the power supply circuit.

20. *Local Induction Controller.* An induction motor-driven controller not equipped with remote reset contacts or other provision for future interconnection, and not capable of maintaining a definite time relationship with other controllers.

21. *Interconnected Induction Motor Controller.* An induction motor-driven controller designed for immediate interconnected operation supervised by a master controller equipped with automatic reset contacts, relay jacks and relays or other means for remote control of traffic signal shutdown, flashing indications and other operating features which may be specified.

22. *Timing Dial.* A calibrated dial or similar mechanism on an automatic timer equipped with adjusting devices by means of which it is possible to divide the time cycle into the required number of intervals and set up the offset and interlock.

23. *Single Dial Timer.* An automatic timer equipped with a single timing dial.

24. *Double Dial Timer.* An automatic timer equipped with two timing dials, mechanically or electrically interrelated so that it is possible to set up and select manually or remotely either of two timing programs.

25. *Triple Dial Timer.* An automatic timer equipped with three timing dials, mechanically or electrically interrelated so that it is possible to set up and select manually or remotely any one of three timing programs.

26. *Time Cycle.* The number of seconds required for one complete revolution of the timing dial or complete sequence of signal indications.

27. *Signal Indication.* The illumination of a traffic signal lens, or equiva-

lent device, or of a combination of several lenses or equivalent devices at the same time.

28. *Interval.* Any one of the several divisions of the time cycle during which traffic control signal indications do not change.

29. *Interval Sequence.* A pre-determined consecutive order of appearance of traffic control signal indications during successive intervals within the time cycle.

30. *Traffic-Phase (Traffic Movement).* A part of the time cycle allocated to any traffic movements receiving the right-of-way or to any combination of traffic movements receiving the right-of-way simultaneously during one or more intervals.

31. *Vehicular-Phase (Vehicular Movement).* A traffic-phase allocated to vehicular traffic.

32. *Pedestrian - Phase (Pedestrian Movement).* A traffic-phase, or traffic-movement allocated exclusively to pedestrian traffic.

NOTE: With multi-circuit, multi-interval controllers, it is important that the number of traffic-phases (traffic movements) be specified because of features such as flashing and all-red which require a number of relays determined by the number of traffic-phases (traffic movements).

33. *In-Time Operation.* A specified timing relationship of the green indication between controllers, in a system of traffic control signals in accordance with a pre-determined timing program.

34. *Through Band.* The time in seconds elapsed between the passing of the first and last possible vehicle in a group of vehicles moving in accordance with the designed speed of a progressive traffic control signal system.

35. *Offset.* The number of seconds or per cent of the time cycle that the green indication appears at a given traffic control signal after a certain instant used as a time reference base.

36. *Offset Dial.* A calibrated dial on an automatic timer equipped with adjusting devices by means of which it is possible to set any desired offset of the beginning of the green traffic control signal indication.

37. *Reset.* An adjustment mechanism applied to an automatic controller providing for the setting up of the timing arrangement of the start of the green traffic control signal indication.

38. *Manual Reset.* A reset by means of which it is possible to manually adjust the offset or beginning of the green.

39. *Automatic Reset.* A reset by means of which the offset or beginning of the green is checked automatically, and adjusted, if necessary, once each time cycle.

40. *Reset Interrupter.* A device which will automatically distribute the time lag resulting from a particular resetting over a period of time varying from one to several cycle lengths.

41. *Double Automatic Reset.* A reset by means of which it is possible to automatically select any one of two automatic resets.

42. *Triple Automatic Reset.* A reset by means of which it is possible to automatically select any one of three automatic resets.

43. *Time Cycle Dial.* A mechanism applied to an automatic timer by means of which it is possible to set up and adjust the time cycle.

NOTE: Time cycle dials are usually present only on induction motor-driven controllers and master controllers.

44. *Time Cycle Indicator.* An indicating device applied to an automatic timer for indicating the time cycle in seconds.

45. *Remote Cycle Change Unit.* A mechanism applied to the timer of the master controller, and/or secondary controller, making it possible, by means of manual or automatic time switch operation, to change the time cycle at all of the secondary controllers within a system.

46. *Power Failure Feature.* A relay mechanism which operates in case of power failure and upon restoration of power causes traffic control signals to operate as flashing signals, or illuminates a power failure indicator, until the controller is restored manually to normal in-time operation.

47. *Power Failure Indicator.* A pilot lamp mounted on or in the controller cabinet which when illuminated indicates that power has failed and that the controller requires manual in-time resetting.

48. *Automatic Time Switch.* An electrically operated device for automatic control of the operation of traffic control signals in any manner prescribed by a pre-determined time schedule.

49. *Shutdown Switch.* A switch in a controller which may be operated by hand to discontinue the operation of traffic control signals.

50. *Shutdown Feature.* A relay, or other device installed in a controller which, when energized from a remote point or by an automatic time switch, discontinues normal traffic control signal operation and turns the signal indications off.

51. *Flashing Feature.* A relay or other device installed in a controller which, when energized from a remote point or by an automatic time switch, discontinues normal signal operation and causes the flashing of any predetermined combination of signal lights.

52. *Emergency Feature.* A relay, or other device installed in a controller, which when energized from a remote point, discontinues the normal signal operation and displays special signal indications for the movement of high speed fire apparatus, etc.

53. *Jack Mounted Relay.* A relay which may be removed or replaced without the use of tools and without disturbing any wiring.

54. *Relay Jack.* A set of clips, plugs or receptacles in a controller or cabinet by means of which a relay may be mounted or connected to the circuit.

55. *Signal Circuit Contact.* A device arranged to energize or de-energize signal light circuits during a specified interval.

56. *Circuit Contact Cam Shaft.* A device to operate the circuit contacts to provide the desired interval sequence.

57. *Radio Interference Filter.* A device to suppress or minimize interference with radio reception.

NOTE: Radio interference filter is to be used only on flashing contacts, because it is not practicable to put them on normally operating signal and control circuit contacts of modern traffic signal controllers. These contacts opening and closing three or four times a minute do not cause objectionable interference.

58. *Panel.* A panel board within the controller cabinet upon which are mounted fuse receptacles, terminals, relays, and electrically operated switches and other equipment, all suitably insulated.

59. *Field Terminals.* Devices mounted on a panel board for connecting all wires entering the controller cabinet.

60. *Yellow - Red Flash Terminals.*

Additional terminals installed in a traffic signal controller so wired that by an interchange of jumpers, flashing operation may be arranged to give either yellow or red on the main or cross streets.

61. *Cabinet.* A dustproof and weatherproof enclosure for housing the controller and associated equipment.

B. SCOPE

The control equipment hereinafter described and classified as to type is to be used in operating traffic control signals in accordance with one or more of the following plans. (Purchaser will here designate the specific plan or plans of operation proposed for the equipment to be purchased.)

Plan #1. One local controller operating an isolated intersection or two or three proximate intersections.

Plan #2. Non-interconnected controllers operating two or more intersections, and maintaining definite time coordination with each other by virtue of all of the controllers involved operating in synchronism with the alternating-current power supply.

Plan #3. Future-interconnected controllers operating temporarily as non-interconnected units and maintaining definite time coordination with each other (as in plan #2 above) but designed for conversion to interconnected operation at some future time.

Plan #4. Interconnected controllers operating two or more intersections and supervised by a master controller. The secondary controllers are to be independently adjustable as to interval timing in accordance with traffic requirements at each of the several intersections, and the green indication at each intersection shall be adjustable to start at any instant as required by the offset timing schedule.

SECTION I
GENERAL DESIGN REQUIREMENTS

NOTE: All paragraphs numbered with two digits to the right of the decimal are OPTIONAL and can be deleted, if desired. Paragraphs numbered with three digits to the right of the decimal contain purely explanatory information.

1. *Purpose*

The purpose of Section I of this specification is to set forth minimum design and operating requirements for all traffic signal controllers of the various types included in this entire specification.

2. *Constancy of Time Cycle*

The time cycle shall be constant and accurate. The time cycle shall not change if the voltage of the power supply varies between the limits of 10 per cent above and 10 per cent below normal, 115 volts, 60 cycle power supply. Similarly, time cycle variations shall not occur, due to any change in outside temperature between the limits of 120°F above and 35°F below zero, preferably without the necessity of any heater elements.

NOTE: The following paragraph 2.11 shall be used in lieu of paragraph 2 above only when it is desired by the purchaser to allow bids on induction (variable speed) motor-driven controllers, for plan #1 above instead of the synchronous (constant speed) motor-driven controllers required by paragraph 2.

2.11 (OPTIONAL) *Constancy of Time Cycle*

The time cycle shall not change by more than 5 per cent of its value if the voltage of the power supply varies between the limits of 10 per cent above and 10 per cent below normal, 115 volts, 60 cycle power supply. Similarly, time cycle variations of more than 5 per cent shall not occur, due to any change in outside temperature between the limits of 120°F above and 35°F below zero, preferably without the necessity of any heater elements.

3. *Constancy of Intervals*

The time of beginning and end of any interval as determined by the settings, shall not change, due to power supply voltage variations at any place on the system between the limits of 10 per cent above and 10 per cent below normal, 115 volts A-C. Similarly, any change in outside temperature between the limits of 120°F above and 35°F below zero shall not cause a change in the time of beginning and end of any interval.

NOTE: The following paragraph 3.11 shall be inserted in lieu of paragraph 3 above only when it is desired by the purchaser to allow bids on induction (variable speed) motor-driven controllers instead of the synchronous (constant speed) motor-driven controllers required by paragraph 3.

3.11 (OPTIONAL) *Constancy of Intervals*

The length of any interval shall not change by more than 5 per cent of its value if the voltage of the power supply varies between the limits of 10 per cent above and 10 per cent below normal, 115 volts, 60 cycle power supply. Similarly interval variations of more than 5 per cent shall not occur, due to any change in outside temperature between the limits of 120°F above and 35°F below zero, preferably without the necessity of any heater elements.

4. *Mechanism*

All mechanism, motors, operating coils, bearings, contacts, relays, flashers, etc., shall be sufficiently large, rugged and accessible in order to insure reliability and minimum maintenance. All contacts shall be of coin or fine silver of sufficient cross-section to perform their normal functions with minimum pitting or burning under maximum current and shall not require fine adjustment and readjustment for satisfactory and continuous operation. All such mechanism shall be neatly and systematically arranged to make possible complete inspection while the controller is operating in accordance with its normal functions.

5. *Cabinet*

5.1 The controller shall be furnished completely housed in a cabinet.

5.2 The controller cabinet shall be of clean-cut design and appearance. The size of the cabinet shall be such as to provide ample space for housing the timer and all of the associated electrical devices which are to be furnished with it, together with any other auxiliary devices herein specified. A hinged door shall be provided permitting complete access to the interior of the cabinet. When closed, the door shall fit closely to gasketing material, making the cabinet weather-resisting and dust-tight. The door shall be provided with a strong lock and a key, and shall have an outside designation: TRAFFIC CONTROL.

5.21 (OPTIONAL) The cabinet shall contain a suitably designed vent for the purpose of releasing any explosive gases which might enter the cabinet.

5.3 The controller cabinet and all mounting attachments are to be finished with two coats of high grade enamel paint. (Color to be specified by purchaser — GREEN recommended.)

5.4 The controller cabinet shall be

provided with necessary openings for mounting and connection as follows:

(Purchaser to specify type of mounting, i.e., pedestal, pole attachment clamps, or integral with post; also complete instructions as to drilling, tapping, etc.)

5.5 The controller cabinet shall contain a strong mounting table, sliding ways, hinged or a folding support of such construction that it will permit the timer to be withdrawn from the cabinet for inspection or maintenance without breaking any electrical connections or interrupting normal operation of the controller.

5.6 The electrical connections from the timer to the outgoing and incoming circuits shall be made in such a manner that the timer may be replaced with a similar unit, without the necessity of disconnecting and reconnecting the individual wires leading therefrom. This can be accomplished by means of a multiple plug and jack, a spring-connected mounting, or equivalent arrangement.

5.7 Each controller is to be furnished with a panel in the cabinet mounted in such a way as to provide visibility and accessibility.

5.71 (OPTIONAL) The cabinet shall also provide space and wiring to permit the installation of an automatic time switch at any time that such equipment may be desired. (Purchaser will insert here the functions of the automatic time switch, i.e., for signal shut-down or flashing indications, or both, and specify space required or type of time switch or switches.)

6. *Wiring*

6.1 All panel wiring shall be neat and firm and the panel shall mount, at least:

(a) Terminal with N.E.C. cartridge fuse receptacle and fuse for power supply line.

(b) Terminal, unfused, for neutral side of power supply line.

(c) Terminals for conductors of signal light cable; one for each signal circuit and one or more terminals for the common conductor.

6.11 (OPTIONAL) The above mentioned terminals shall be located at least three inches from the bottom of the cabinet and arranged for adequate electrical clearance between terminals.

6.2 The controller equipment and terminals shall be so arranged within the cabinet that they will not upset the entrance, training and connection of the incoming conductors.

6.3 All field terminals shall be suitably identified.

6.31 (OPTIONAL) The outgoing traffic control signal circuits shall be of the same polarity as the line side of the power supply; the common return of the signal circuits shall be of the same polarity as the grounded side of the power supply.

6.4 The grounded side of the power supply shall be carried throughout the controller in a continuous circuit and shall be grounded to the controller cabinet in an approved manner.

7. *Variation in Setting of the Time Cycle*

7.1 It shall be possible to accurately set or adjust the time cycle between the limits of 30 and 120 seconds with accurate and definite settings within this range in 5 second steps up to 90 seconds, and 10 second steps above 90 seconds.

(The purchaser will insert here which five time cycle gears are to be furnished with each controller.)

NOTE: Two-traffic-phase controllers are generally operated within the 40 to 80 second range; three traffic-phase controllers within the 50 to 90 second range.

7.2 It shall be possible to set a local controller unit to operate at any of the above time cycle settings by adjusting an accurately calibrated dial or by means of a change of marked gears, which latter act shall entail no more than the use of simple tools.

8. *Interval Sequence*

8.1 The timer shall provide and be set up for consecutive divisions of the time cycle hereinafter termed "intervals" during which combinations of traffic control signal indications do not change.

8.2 Each two-traffic-phase controller shall provide for a minimum of (4) (6) (9) (12) or (16) consecutive intervals. (Number of intervals to be specified by purchaser.)

8.3 (The desired interval sequence of operation is to be inserted at this point in the specification by the purchaser.)

9. *Interval Setting and Adjustment*

9.1 The controller shall provide for the setting up of each interval of the time cycle by means of a positive setting on a calibrated dial. The dial shall, at all times, show a visual indication of the exact percentage of the time cycle allocated to each interval. The time duration of each interval shall be exactly as indicated in per cent of the time cycle.

9.2 The timing dial shall be provided with a scale calibrated in one per cent steps and shall provide for the accurate setting of any interval within the range of adjustment of from two per cent to 85 per cent of the time cycle. The minimum time for any interval will be one and one-half seconds whenever that is greater than two per cent of the time cycle.

9.3 The timing dial shall be on the front of the timer, easily identifiable and it shall not be necessary to remove or change wires or contacts or to use any tools in making interval adjustments.

9.4 The time of all intervals as determined by the percentage timing dial settings shall increase or decrease in exact proportion to any increase or decrease of the time cycle setting.

9.41 (OPTIONAL) (Three)-(Two) timing dials or separate scales shall be provided in each local controller for setting up (three)-(two) separate and distinct programs of interval timing. Each timing dial or scale for interval timing shall have all the flexibility, etc., as described above. The (triple)-(double) percentage setting of intervals shall be readily identifiable as such and change of one of the (three)-(two) interval settings shall not interfere with or alter the other interval setups. Means shall be provided for transfer from one interval setup to another by means of electrical control, possible of operation either by manual operation or by means of automatic time switches. The controller shall be so arranged that such transfer from one interval setup to another shall be accomplished during the main street green, (interval number to be specified) so that merely a longer or shorter timing of this interval will result during the change-over and so that there shall be no chance for improper timing of the other intervals. From the time of electrical call for transfer, not more than two time cycles shall be required for complete transfer to another interval setup.

10. *Signal Circuit Contacts*

10.1 Controllers shall be provided with a suitable mechanism for closing and opening signal light circuits, that can be arranged or rearranged to cause any signal light circuit to be energized or de-energized during any one of the

previously specified intervals. This shall be easily possible by the use of simple tools without returning the controller or any part thereof to the factory.

10.2 At least (6) (9) (12) or (15) separate pairs of contacts for the type of controllers specified shall be provided. (Number of contacts to be specified by purchaser.)

10.201 Examples of listing the signal circuits contacts are shown below:

Two-Traffic-Phase Controller
(6 Contact)

Main Street	Cross Street
Green	Green
Yellow	Yellow
Red	Red

10.202
Two-Traffic-Phase Controller
(8 Contact)

Main Street	Cross Street
Green	Green
Yellow	Yellow
Red	Red
Walk	Walk

10.203
Two-Traffic-Phase Controller
(12 Contact)

Main Street	Cross Street
Green (N)	Green
Flashing Green (N)	Yellow
Green (S)	Red
Flashing Green (S)	Walk
Yellow	Spare
Red	
Walk	

10.204
Three-Traffic-Phase Controller
(9 Contact)

Street "A"	Street "B"	Street "C"
Green	Green	Green
Yellow	Yellow	Yellow
Red	Red	Red

NOTE: Various interval sequences and special traffic control signal indications may require a greater number of contacts than specified above. For instance, in a three-traffic-phase controller, contacts for WALK indications might be desirable. Then, too, if the flashing green feature is used separate contacts for signal indications facing traffic on each approach, cross, as well as main street, might be required. Spare contacts provide for future additional flexibility thereby forestalling early obsolescence of the controller.

10.3 The closing or opening of the signal circuit contacts shall be positive without objectionable dark intervals, flickering of lights or conflicting signal indications. Each pair of contacts shall have a capacity of not less than 10-amps at 115 volts A-C without undue burning or pitting.

11. *Turning Signal Lights Off*

Each intersection controller shall be provided with a switch for shutting down the signals at the intersection. On synchronous controllers this switch shall affect the power supply to the signals only and no other part of the controller.

12. *Flashing Feature*

12.1 For use during periods of low traffic volume or emergency conditions means shall be provided to permit the substitution of flashing signal indications for normal automatic time cycle. (Flashing combinations to be specified by purchaser.) The flashing indications shall be at the rate of not less than 50 nor more than 60 flashes per minute with approximately 50 per cent on and 50 per cent off periods. The rapidity of flashes shall not vary with the change of time cycle. The closing and opening of the flashing contacts shall be accomplished in such a manner as to avoid undue pitting and burning at 10-amps, 115 volts, A-C continuous make and break duty.

12.2 Controllers shall be equipped with yellow-red flash terminals. (See Definition #60.)

12.21 (OPTIONAL) The flasher contacts in each local controller shall be equipped with adequate radio interference filters.

NOTE: Radio interference filter is to be used only on flashing contacts, because it is not practicable to put them on normally operating signal and control circuit contacts of modern traffic signal controllers. These contacts opening and closing three or four times a minute do not cause objectionable interference.

13. *Manual Control*

13.11 (OPTIONAL) For use under special conditions, intersection controllers shall be provided with means for substituting local manual operation of the signal lights for the normal automatic interval sequence of signal indications.

13.12 (OPTIONAL) Manual operation shall provide the same interval sequence as when the controller is operating automatically. Local manual operation shall be obtainable by means of a weather-resisting switch. The transfer from manual to automatic operation, or vice versa, shall be accomplished by a single switching operation. It shall not be necessary, when switching from manual to automatic operation, or vice versa, to do so at any certain time or to make any time adjustments whatever.

14. *Uninterrupted Timing*

14.1 Any changes in operation of traffic control signal lights as described in paragraphs 11 and 12.1 shall not interfere with the continued in-time operation of the timer motor in each controller. A transfer from such special operations back to normal automatic operation shall immediately reestablish the normal time cycle and subsequently the in-time relation.

15. *Guaranty*

Each manufacturer shall include in his proposal all warrants and/or guarantees with respect to materials, parts, workmanship, or performance which the products covered by the proposal bear.

SECTION II
NON-INTERCONNECTED CONTROLLERS

1. *Purpose*

The purpose of Section II of this specification is to set forth certain functional requirements which apply specifically to controllers of the non-interconnected type, (or to controllers for isolated operation as in Plan #1, above. Also see Note, Paragraph #2 below).

2. *Design Requirements*

The general design requirements in Section I apply in addition to specific functional requirements hereinafter described.

NOTE: Functional requirements in Section II apply primarily to synchronous motor-driven controllers as required in Section I, Paragraph 2. If the purchaser desires to allow bids on induction (variable speed) motor-driven controllers by using Section I, Paragraph 2.11, it is to be understood that progressive timing of non-interconnected controllers is impossible

(unless a synchronous supervisory mechanism also is furnished). Consequently when bids are allowed on induction motor-driven controllers paragraphs 4, 4.11, 4.2, 5, 6, 6.11, 6.12 and 6.13 of Section 2 do not apply and the purchaser shall so indicate.

3. *Flashing Feature*

The substitution of flashing traffic control signal indications for the normal time cycle shall be obtainable at each controller by a manual switch or automatic time switch and necessary relays. (Specify which.)

4. *Time Cycle*

4.11 (OPTIONAL) The non-interconnected controller shall, at all times, give a visual indication of the exact time cycle at which the controller is operating.

4.2 (The purchaser will insert here which five time cycle gears are to be furnished with each controller.)

5. *Offset*

Each local controller for non-interconnected operation shall be provided with a simple, readily accessible switch or equivalent for stopping the timing dial of the controller within two seconds or at the start of the proper offset position.

5.11 (OPTIONAL) The above switch for use in making accurate setting of the offset or start of green relationship between controllers is to be provided with a simple locking device so that simple tools will be necessary for the operation of same.

6. *Power Failure Feature*

6.11 (OPTIONAL) Control equipment furnished for non-interconnected operation shall include apparatus whereby an automatic transfer will be made from the normal interval sequence to the same flashing combination set forth in paragraph #12 of Section I upon resumption of power supply after a failure thereby indicating that the controller may be out of time with the other controllers in the system.

6.12 (OPTIONAL) (Alternative to Paragraph 6.11 above.) Controller equipment furnished for non-interconnected operation shall include apparatus whereby a pilot lamp, mounted on, or in, the cabinet, will be lighted and remain illuminated upon resumption of power supply after a failure thereby indicating that the controller may be out of time with other controllers in the system.

6.13 (OPTIONAL) The return to normal interval sequence shall be made by a manual relay reset rather than by a switch.

SECTION III
FUTURE INTERCONNECTED CONTROLLERS

1. *Purpose*

The purpose of Section III of this specification is to set forth certain functional requirements which apply specifically to controllers designed for temporary operation in a non-interconnected traffic control signal system but which shall also be designed for easy and inexpensive conversion into inter-connected controllers of a specified type as hereinafter described in Section IV.

2. *Design Requirements*

The general design requirements in Section I and functional requirements in Section II apply in addition to specific requirements hereinafter described.

3. *Equipment*

Controllers in this classification shall be initially furnished with:

a. Identified terminal and fuse for each future interconnecting conductor.

b. Complete wiring for such future interconnection including jacks for shutdown and flashing relays.

c. Single automatic reset feature.

d. Synchronous motor (or provided with a synchronous supervisory mechanism) to insure a constant time cycle and allow progressive timing until such time as interconnection to a master controller is made.

4. *Conversion*

Controllers shall be so furnished that by the simple addition or interchange of readily accessible parts, without being returned to the manufacturer, conversion from future-interconnected type to interconnected type may be readily accomplished.

SECTION IV
INTERCONNECTED CONTROLLERS

1. *Purpose*

The purpose of Section IV of this specification is to set forth certain functional requirements which apply to interconnected type of controllers.

2. *Design Requirements*

The general design requirements in Section I apply in addition to specific functional requirements hereinafter described.

3. *Offset Start of Main Street Green Progressive Timing*

3.1 Each local controller for interconnected operation with supervision from a master controller shall be provided with a dial adjustment for setting the offset relation of the local controller with respect to the other local controllers and the master. The offset dial shall be calibrated in one per cent steps from 0 to 100 per cent and shall give a visual indication of the per cent offset lag at which the controller is operating.

3.11 (OPTIONAL) Each local controller unit shall be provided with a dial adjustment for setting 2 or 3 offset relationships (purchaser to specify which) of the controller with respect to other controllers. The offset scale shall be calibrated in one per cent steps from 0 to 100 per cent and shall give a visual indication of the per cent lag of each of the settings of the start of the green. Transfer from one offset to another timing of the local controller shall be obtainable by selection at the master controller.

3.2 Timing of the main street green relationship between the interconnected controllers shall be fully automatic in accordance with the offset time setting.

3.3 In changing the offset or relation of start of main street green at a given intersection with respect to the system, it shall not be necessary to change or rearrange the individual interval adjusting devices.

4. *Interval Setting and Adjustment*

4.11 (OPTIONAL) Local controllers for interconnected operation having (double) (triple) percentage settings of intervals, Section I, paragraph 9.41, shall be designed for remote selection of interval setup from the master controller.

5. *Remote Cycle Change*

5.11 (OPTIONAL) When controllers are interconnected in a system and supervised by a master controller so as to provide remote change of time cycle, changes in the local controller cycle settings, Section I, paragraph 7, shall be obtainable at the master controller.

6. *Remote Control of Signal Shutdown*

6.11 (OPTIONAL) Controllers shall be provided with relays so that when interconnected in a system and super-

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vised by a master controller, the turning off of intersection signal lights, Section I, paragraph 11, shall be obtainable at the master controller.

7. *Remote Control of Flashing Feature*

7.11 (OPTIONAL) Controllers shall be provided with relays so that when interconnected in a system and supervised by a master controller, the flashing feature for signal lights at all local controllers, Section I, paragraph 12, shall be obtainable at the master controller.

8. *Equipment*

The panel shall be provided with terminal and fuse receptacle with N.E.C. cartridge fuse for each interconnecting conductor excepting the neutral.

SECTION V
MASTER CONTROLLER

1. *Purpose*

The purpose of Section V of this specification is to set forth certain functional requirements which apply specifically to a master controller.

2. *Design Requirements*

The general design requirements in Section I apply in addition to specific functional requirements hereinafter described.

3. *Equipment*

The master controller for an interconnected traffic control signal system is to consist of the necessary apparatus to provide supervisory functions under normal operation as described in Section IV.

4. *Supervisory Functions*

The supervisory functions obtainable at the master controller are as follows:

4.1 Means for automatically establishing offset time relations of local controller.

4.11 (OPTIONAL) Hand operated switch for varying time cycle setting of all interconnected local controllers and keeping them on the same time cycle as the master controller.

4.12 (OPTIONAL) Hand operated switch for turning off completely all traffic control signal lights at interconnected local controllers.

4.13 (OPTIONAL) Hand operated switch for transfer of traffic control signal lights at each local controller to give flashing indications.

4.14 (OPTIONAL) Hand operated switch for transfer of traffic control signal lights at each local controller to give emergency signal indications.

4.15 (OPTIONAL) Hand operated switch for selecting offset at which all interconnected local controllers shall operate in accordance with three distinct timing plans.

4.16 (OPTIONAL) Hand operated switch for selecting (two) (three) interval setups on which each of the interconnected local controllers shall operate.

4.2 The above flexibilities 4.12, 4.13, 4.14, 4.15 and 4.16 shall each be obtainable, when specified, by means of automatic time switches. In the latter case the automatic switching schedule shall be as follows:

(Attach Schedule)

5. *Motor*

The master controller shall be driven by a synchronous motor or be provided with a synchronous control mechanism which will maintain a constant time cycle.

5.11 (OPTIONAL) (Where it is not necessary to keep a traffic control signal system in step with adjacent such systems or adjacent non-interconnected controllers, an induction motor driven master controller may be specified.)

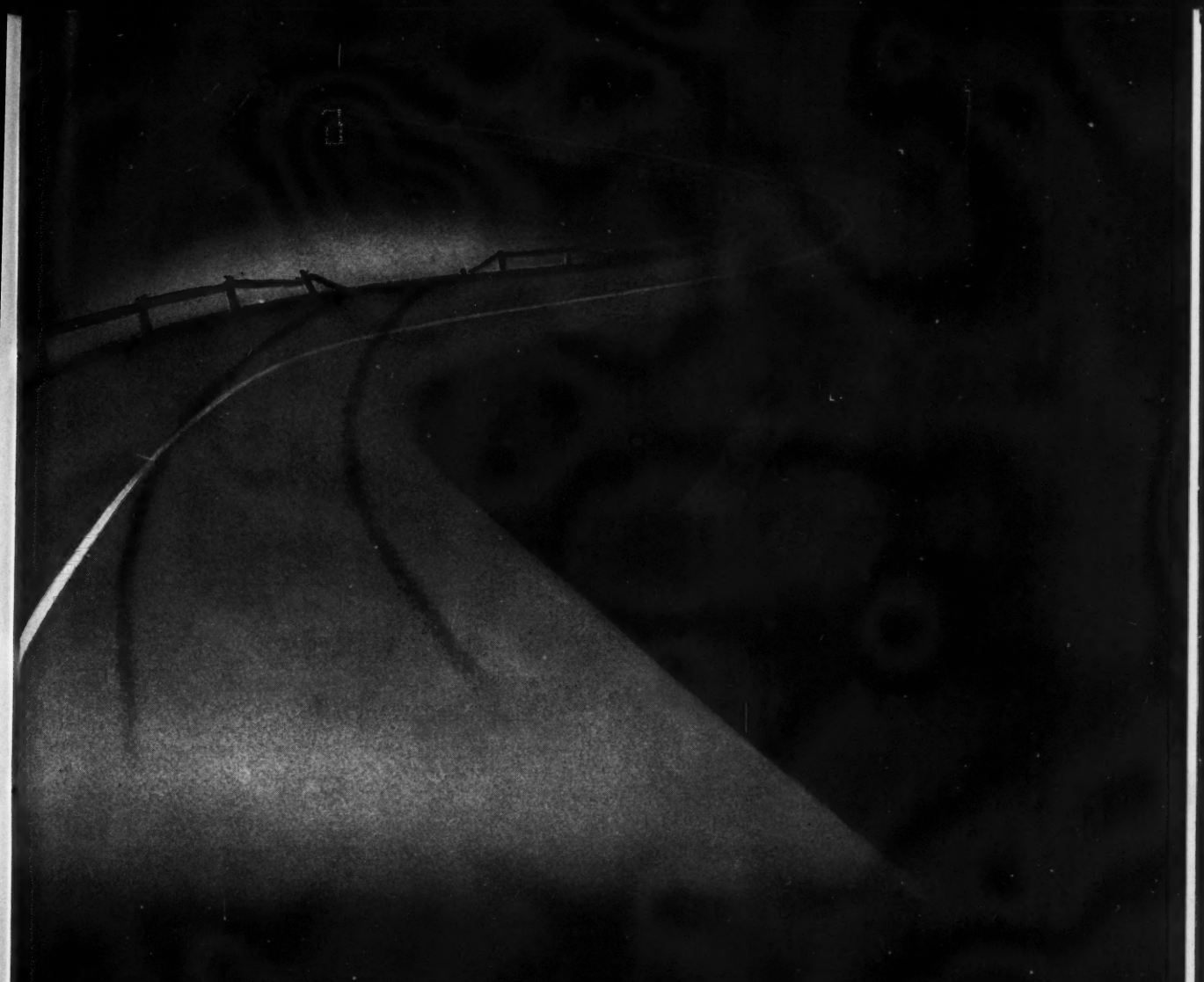
6. *Time Cycle*

6.1 The variation of the time cycle settings of all interconnected local controllers shall be accomplished by a simple adjustment at the master controller. There shall be at all times an accurate visual indication of the time cycle at which the traffic control signal system is operating.

6.2 It shall be possible to accurately set or adjust the time cycle between the limits of 30 and 120 seconds with accurate and definite settings within this range in 5 second steps up to 90 seconds and 10 second steps above 90 seconds. (The purchaser will insert here the specific time cycle gears which are to be furnished with each master controller.)

7.11 (OPTIONAL) *Special Equipment*

(In traffic control signal systems not requiring remote time cycle change supervision, a combined master and secondary controller may be used in place of a master controller. Such a controller would consist of a secondary controller equipped with additional supervisory contacts for automatic reset functions and other supervisory functions, as specified.)



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Reference Notes

Report on Expansion in the Uses of Radio and Availability of Radio Frequencies for Highway Department Purposes As a Result of Recent Federal Communications Commission Actions

H. A. Radzikowski
Chief, Division of Development
and
W. D. Dillon
Chief, Procedures and Operations Branch
Division of Development, Office of Operations
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THROUGH THE American Association of State Highway Officials' Committee on the Use of Radio in Highway Departments, a brief was filed with the Federal Communications Commission asking for additional frequencies to relieve the overcrowded conditions in the use of radio facilities for highway purposes. Over 400 highway departments, including 40 State highway departments now use radio telephone in their official activities. State highway departments, as a result of petitions filed with the FCC in 1949, had obtained approval of a national assignment plan for the use of 14 frequencies in the 47 megacycle band. These frequencies were allocated exclusively for use by State highway departments. All other highway departments, including counties and cities, because of the unknown interest of those users at the time, had 6 frequencies in the 33 to 37 megacycle band shared with special emergency groups. There were available an additional 44 frequencies in the 152-162 mc. band but they could seldom be authorized to county and local highway departments since they were shared on a second priority basis with the railroad and maritime services. This limited number of frequencies resulted in the crowded conditions as more highway department systems, were installed.

Consistent with the above briefs that have been filed, the FCC has now granted a substantial part of the highway departments' request for relief and has the remainder under consideration.

Expanded Use of Radio For Highway Purposes

1. The FCC extended the permissible use of radio frequencies to "those essential to any official activity of the licensee." Under this new definition, highway departments may transmit communications essential to construction, operation, administration, traffic control, or any other official activities.

2. Authority was granted by the FCC to install highway department radio units in vehicles of highway contractors when the State highway department finds it desirable to do so.

3. Highway departments may now, on their assigned frequencies, transmit communications necessary for the implementation of Civil Defense activities assigned such station by the local Civil Defense authorities during an actual or simulated emergency including drills and tests.

4. Since contractors are an important part of the highway team, their needs for additional frequencies were supported before the FCC. A new Business Radio Service has now been proposed but not yet established by the FCC. The frequencies which have been proposed for the new service, however, are now available to highway contractors in the Special Industrial Radio Service.

5. The use of radio frequencies has been authorized by the FCC for the remote control from a central point of the timing of traffic signals in Chicago, Illinois, Wayne County, Michigan, Syracuse and New York City, New York. This new development not only permits the timing of the lights to be instantaneously changed to secure the optimum flow of traffic but also reduces the cost and delays to traffic by eliminating the tearing up of streets and installation of cables.

6. The FCC has also authorized the use of radio frequency transmitters in emergency vehicles for controlling traffic lights. As a vehicle so equipped approaches an intersection, a signal is sent out which is picked up by a radio receiver on the traffic light causing red to show in all directions. The light returns to its normal cycle when the emergency vehicle clears the intersection.

7. The use of radio frequencies to operate the tellurometer has greatly expedited the measurement of long lines in control and other surveys.

8. Authorization has been secured for several States to transmit on each other's frequencies in a thirty mile wide strip on either side of their common boundary. This linkage of the two statewide radio systems enables the States to exchange weather and road information very quickly as well as to cooperate in emergencies.

9. Radio was used on the AASHO road test in Illinois to transmit the results of density tests from the laboratory to the appropriate road section, thereby greatly expediting the progress of construction. Radio permits instruction to be given to drivers of test vehicles and test data to be relayed from those vehicles without stopping them.

10. Induction radio is now being used in several States to advise drivers as they move along the highway of traffic and road conditions ahead, the location of business establishments and for other routine and emergency purposes.

11. Linkage of Bureau of Public Roads and State highway department officials by radio has been accomplished in several States to expedite the progress of the Federal-aid highway program.

12. Other beneficial uses of radio for highway purposes that have been authorized are:

a. Telemetering data from traffic counters to a central office for analysis.

b. Transmission of documents by radio facsimile.

c. Operation of steering and braking controls in a motor vehicle used in guardrail tests.

d. Intercommunication between members of survey parties.

Availability of Radio Frequencies

1. The FCC has doubled the number of frequencies that are now available to highway departments in the band between 47.02 mc. and 47.40 mc. by splitting the width of each cahnnel from 40 kc. to 20 kc. The new split channels can be authorized as soon as the revised national geographical frequency assignment plan that is being prepared is approved by the FCC. This plan is being engineered so that the communications of one highway department, because of the special characteristics of space radio, will not interfere with the communications of another highway department, and so that highway departments may have maximum opportunity to utilize the radio frequencies.

2. An additional 5 channels from 150.995 to 151.115 mc. were made immediately and exclusively available to highway departments.

3. The FCC has also made available 18 additional frequencies in the 450 to 460 mc. band. These additional frequencies were obtained by narrowing the band widths from 100 kc. to 50 kc.

4. Additional frequencies have been requested for use by highway departments and may become available soon as a result of actions now pending before the FCC. These include:

a. Twenty-three frequencies in the 152-162 mc. band that have been allocated but will not be available for authorization to highway departments until November 1963. However, action on a docket now pending before the FCC may make these frequencies immediately available.

b. Six low band frequencies are being held in reserve by the FCC for a future allocation to the Public Safety Radio Services including highway departments.

c. The FCC has recognized the request of highway departments for additional frequencies for remote control of traffic signals and multi-message signs, for telemetering and other uses. The Commission has agreed to issue a Notice of Inquiry in the near future for the purpose of determining requirements.

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Get accurate axle load data with no interruption of truck traffic. Trucks are weighed at all normal speeds with Cox & Stevens Electronic Highway Scales. Record axle weights, total weights, speeds and axle spacings on permanent tape.

Motion weighing eliminates delays for trucks... keeps the good will of the trucking industry. Scale platforms are set flush in the highway on weather-proof electronic load cells. No moving parts. Platform deflects only a few thousandths under load. Recording instruments that go along with scale are portable to collect data from scales at various locations.

Cox & Stevens electronic motion-weighing equipment is now installed in Iowa, Virginia, Minnesota and Oregon. Find out how these scales of the future can help your highway planning program today.

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- ☆ Compact Scale Instrumentation — Portable if necessary.
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- ☆ Accurate at Wide Speed Range — Records true weights at all normal truck speeds.

30

Write for bulletin 3005.

ELECTRONIC SIGNAL CO., INC.
19 West 50th Street, New York 20, N. Y.

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Coming Events

September 16-20 — FOURTH INTERNATIONAL STUDY WEEK IN TRAFFIC ENGINEERING—
Copenhagen, Denmark, Contact: World Touring and Automobile Organization, 32 Chesham Place, London, SW1, England.

September 28-October 1 — AMERICAN PUBLIC WORKS ASSOCIATION—
Muehlebach Hotel, Kansas City, Mo. Contact: APWA, 1313 E. 60th St., Chicago, Ill.

October 13-15 — AMERICAN TRANSIT ASSOCIATION—
Roosevelt Hotel, New Orleans, La. Contact: ATA, 292 Madison Ave., N.Y.C.

October 13-17 — AMERICAN SOCIETY OF CIVIL ENGINEERS—
National Convention, Statler Hotel, New York City. Contact: ASCE, 29 W. 39th St., N.Y.C.

October 20-23 — INTERNATIONAL MUNICIPAL SIGNAL ASSOCIATION—
Sheraton Hotel, Philadelphia, Pa. Contact: IMSA, 130 W. 42nd St., N.Y.C.

October 20-24—NATIONAL SAFETY CONGRESS
Conrad Hilton, Congress and other hotels, Chicago, Ill. Contact: NSC, 425 N. Michigan Ave., Chicago, 11, Ill.

October 23-24—NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS—
St. Francis Hotel, San Francisco, Calif. Contact: NSPE, 2029 K St. N.W., Washington 6, D.C.

October 26-30 — AMERICAN INSTITUTE OF PLANNERS—
New Yorker Hotel, New York City. Contact: AIP, Suite 410, 2400 16th St., N.W., Washington 9, D.C.

October 26-31—INTERNATIONAL ASSOCIATION OF CHIEFS OF POLICE—
Hotel Fontainebleau, Miami Beach, Fla. Contact: IACP, 618 Mills Bldg., N.W., Washington 6, D.C.

October 26-31 — INTERNATIONAL ROAD FEDERATION THIRD WORLD MEETING—
Mexico City, D.F. Contact: IRF, 1023 Washington Bldg., Washington 5, D.C.

November 10-14 — INSTITUTE OF TRAFFIC ENGINEERS—
28th Annual Meeting, Deauville Hotel, Miami Beach, Florida. Contact: ITE, 2029 K St.,NW, Washington 6, D.C.

November 28-December 5—AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS—
Annual Meeting, Sheraton-Palace Hotel, San Francisco, Calif. Contact: AASHO, National Press Bldg., Washington 4, D.C.

November 30 - December 3 — AMERICAN MUNICIPAL ASSOCIATION —
Hotel Statler, Boston, Mass. Contact: AMA, 1625 H Street N.W., Washington 6, D.C.

1959

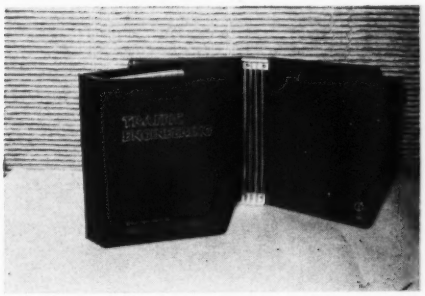
January 5-9 — HIGHWAY RESEARCH BOARD —
Sheraton Park Hotel, Washington, D. C. Contact: HRB 2101 Constitution Ave., Washington 25, D.C.

City Traffic Engineers Listed

A list of city traffic engineers, listed by city, has been prepared by the headquarters office of the Institute of Traffic Engineers. Included in the list are the names of the chief traffic engineers in all cities over 45,000 population, when such names could be determined. There are many blanks in the list, and it is hoped that some of them can be filled in by members of the Institute and others.

Copies of the list are available without charge as long as the present supply lasts. Write: Institute of Traffic Engineers, 2029 K Street NW, Washington 6, D.C., and ask for the list of city traffic engineers.

By Popular Demand



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Reference Notes

Results of Computer Census

In the late 1940's a prediction was made that "fewer than a dozen electronic computers will be able to satisfy the entire computational requirements of this country." Whether or not use of a computer would have improved the accuracy of this forecast will never be known. What is known, as a result of a census of digital computer installations completed last week by the research staff of John Diebold & Associates, Inc., is that a total of 241 large scale and 1036 medium scale computers have already been installed. When added to the 4,720 small scale machines in the field, a whopping total of nearly 6,000 digital computers is reached.

That even this impressive total is not yet satisfying the "entire computational requirements of the country" is evident in the approximately 3,267 (279 large scale, 1,321 medium scale and 1,667 small scale) computers currently on order from U.S. manufacturers.

Clearly, the digital computer has arrived as a working tool of business and industry. To the engineering development of the 1940's and scientific usage of the early 1950's has been added a new phase—major and widespread business application.

The figures presented in the accompanying tables understate the number of actual digital installations for the following reasons:

"One of a type" general purpose machines, primarily built for scientific and engineering work, are not included. This should account for something in excess of 60 additional machines, primarily large scale. Special purpose machines are not included. Depending upon definition, the number of these would vary widely. They would fall predominantly into the medium and small scale categories.

An undetermined number of special military computers, such as the truly giant Sage computers, are not included. A significant number of classified machines are known to exist.

Computers of foreign manufacture have not been included.

Computer manufacturers are considerably more chary these days about parting with "on order" figures than they were a year or two ago when many rather startling totals were freely bandied about. The current reluctance may well be due to anticipation of a declining rate of new orders during 1958 — a potential result of both the general economic recession and the soul searching already underway by many users as to the effectiveness of utilization of the computers they already possess. Manufacturers, of course, advance quite different reasons for their reticence to part with the "on order" figures. These range from IBM's antitrust consent decree, on the one hand, to Remington Rand's "against company policy."

IBM Climbs Ahead In Large Scale Deliveries

IBM, still the leader in installations of computers of all sizes, has increased its portion of the total number of

MEDIUM SCALE GENERAL PURPOSE DIGITAL COMPUTERS

Manufacturer	*Computer*	*Delivered*	*On Order*
IBM	650, 650 w/tapes	750 plus	1,200†
Bendix Computer Div.	G-15	104	unknown
Burroughs Corp.	Datatron 205	81	70†
Alwac Corp.	Alwac II§	2	0
	Alwac III§	6	0
	Alwac III-E	27	8
	Alwac III-E w/tapes	2	7
National Cash Register	102§	30	0
	303§	1	0
	304	0	6
Remington Rand	Univac File Computer O	12†	29†
	Univac File Computer I	3†	unknown
Underwood Corp.	Elecom 100§, 120§, 120A§, 125§, 200§	13	0
J. B. Rea Co.	Readix	3	1
Monroe Calculating Machine Co.	Monrobot VII§, VIII§	2	0
Total Medium Scale Computers		1,036	1,321

†=*Unofficial estimate;* §=*No longer in production*

John Diebold & Associates Annual Computer Census

LARGE SCALE GENERAL PURPOSE DIGITAL COMPUTERS

Manufacturer	*Computer*	*Delivered*	*On Order*
IBM	701§	9	0
	702§	11	0
	704	72	
	705	73	200†
	709	0	
Remington Rand	1101, 1102§	10†	0
	1103, 1103A	25†	15†
	Univac I	36†	12†
	Univac II	1†	30†
RCA	Bizmac 1§	3*	0
	Bizmac II	0	2*
Datamatic Corp.	Datamatic 1000	1	7
Philco Corp.	Transac S-2000	0	4
Burroughs Corp.	Datatron 220	0	9
Total Large Scale Computers		241	279

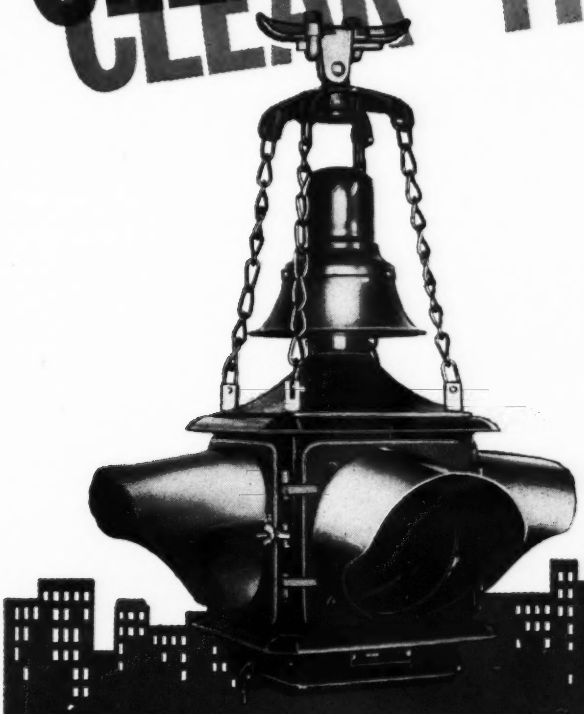
†=*Unofficial estimate;* §=*No longer in production*

Reprinted from ADP NEWSLETTER edited by John Diebold & Associates, Inc., March 3, 1958.

CLEAR THE LANE

say it
twice with this
EAGLE

BEACON SIREN



Drivers see the flashing light over the noise of traffic and car radios, hear the siren warning though vision may be obscured. This double-warning, all-the-safety unit may be suspended at fire lane intersections, or mounted on mast arm or post top. Non adjustable beacon-siren like that shown may have flasher mounted internally.

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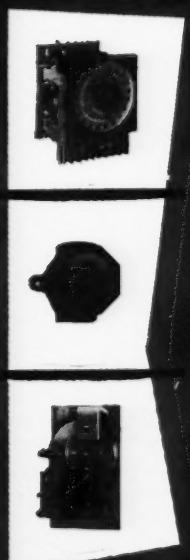

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Automatic Reset-shown "on" interval. Adjusts from 2 seconds to 30 minutes.

PUSH BUTTON SWITCH
Weatherproof, actuates Time Limit Switch shown above.

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One circuit at sixty flashes per minute operates the flashing beacon. The other circuit operates at 80 "wails" per minute.

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Dept. TE-958, Moline, Illinois
Please send complete information on Eagle's new emergency traffic control system.

NAME AND TITLE

MUNICIPALITY

FULL ADDRESS

SMALL SCALE GENERAL PURPOSE DIGITAL COMPUTERS

Manufacturer	*Computer*	*Delivered*	*On Order*
IBM	604	3,500	
	607	350	
	608	1	
	610	0	1,500†
	CPC	60†	
	Ramac 305	20	
	Ramac 650	0	
Remington Rand	Univac 60 and 120	500†	100†
Burroughs Corp.	E-101	164	30†
Royal Precision Corp.	LGP-30	102	15
Underwood Corp.	Electronic Business Computer (formerly Elecom-50)	12	10
Monroe Calculating Machine Co.	Monrobot III§, V§	2	0
	Monrobot VI§	9	0
	Monrobot IX	0	12
Total Small Scale Computers		4,720	1,667

†=*Unofficial estimate;* §=*No longer in production;* *=*Bizmac totals are for number of installations, not numbers of computers.*

Total All Sizes Computers		5,997	3 267

large scale general purpose computer installations by about 6%, raising it from 62% eighteen months ago to 68%, according to this survey and an earlier JD & A survey completed in September of 1956 (See ADP Newsletter Vol. I, No. 10). Remington Rand now shows 30% of the deliveries in contrast to 37% a year and one-half earlier. New machines such as Burrough's Datatron 220 and Philco's fully transistorized Transac S-2000, the first of which is scheduled for installation in August of this year, could easily alter the large computer market picture. Additional installations of the Datamatic 1000 and the Bizmac II are expected to produce some additional changes.

Bendix Climbs to Second Place In Medium Field

Bendix Computer Division of Bendix Aviation Corp., however, has climbed rapidly from fourth to second place in the number of medium scale computers delivered. With only 4% of the market in the earlier survey, Bendix now holds a 10% slice. IBM has dropped from 80% to 75% of this market, according to the recent survey. Remington Rand, slow in getting its File Computers into production, has just begun to figure in this market and still accounts for less than 2% of the installations. Burroughs Corp., formerly occupying second place in this market, scarcely has been able to maintain its long-standing 8% share of the medium scale computer deliveries.

In fourth place is Alwac Corp. with about 4% of the medium scale installations. National Cash Register, having discontinued its Model 102 some time ago, recently announced its readiness to take orders for the new fully transistorized NCR-304. (See Newsletter Vol. II, No. 20) Two companies, Monroe Calculating Machine Co. and Underwood Corp., have dropped out of the medium scale computer market, shifting emphasis to their small scale machines. J. B. Rea's total installations have not altered since the earlier survey.

Royal Precision Shows Fastest Growth Rate In Small Market

Although occupying only fourth place, Royal Precision Corp. presents the fastest growing element in the small scale computer market. The remarkable performance of the firm is evidenced by reports of no LGP-30 installations eighteen months ago, 33 in July, 62 in October, and 104 this February. Still one notch ahead of Royal Precision is Burroughs Corp. which has more than tripled its deliveries of E-101 computers since the earlier survey. IBM, and to a lesser extent Remington Rand, are still the dominant elements in the small computer market. IBM's new 610 machine is very likely to soon take as leading a role in the small scale market as their 650 has in the medium scale field.

Reference Notes

Truck Turning Path Study

By Glen L. Clark
Senior Traffic Analyst,
Oregon State Highway Department

A need recently developed in Oregon for detailed wheel path information concerning truck-tractor and semi-trailers in the range from 50 to 60-foot over-all lengths. This need arose due to the increased number of applications for special permits for operation of trucks over 50 feet in length. Occasionally these applications resulted in intersection revision in order to successfully complete a test run without crossing the painted center line. In addition, the 1957 Legislature approved the operation of 60-foot semi-trailers over selected State Routes.

An extensive study conducted in 1949 by the California Division of Highways supplied path information for truck-tractor and semi-trailers with a 50-foot over-all length. The Highway Department's current design information did not cover the higher range of trucks from 50 to 60 feet in sufficient detail for minimum design work, however.

Scale representations of truck paths were prepared from actual test runs of four truck-tractors and semi-trailers. This study closely followed the field method of the California investigation. The four trucks used in this study included two standard vehicles, semi-trailers, 53.1 and 57.6 feet in length and two "dromedarys," 56 and 60 feet in length. The field portion of the study, conducted on the Aurora Airstrip during September of 1957, was accomplished with rigid control of all variables in an effort to assure the best possible accuracy. Surveyed guide lines were painted on the asphalt. The trucks maintained the slowest possible speed and were guided along these lines with hand signals. The exception to this was for the minimum left and right turns. The wheel paths were chalked and immediately surveyed after each test run.

It was planned that each of the four trucks used would make 13 controlled turns. These were to include minimum left and right turns with central angles of 90° and 120°. Pavement markings installed also provided guide lines for

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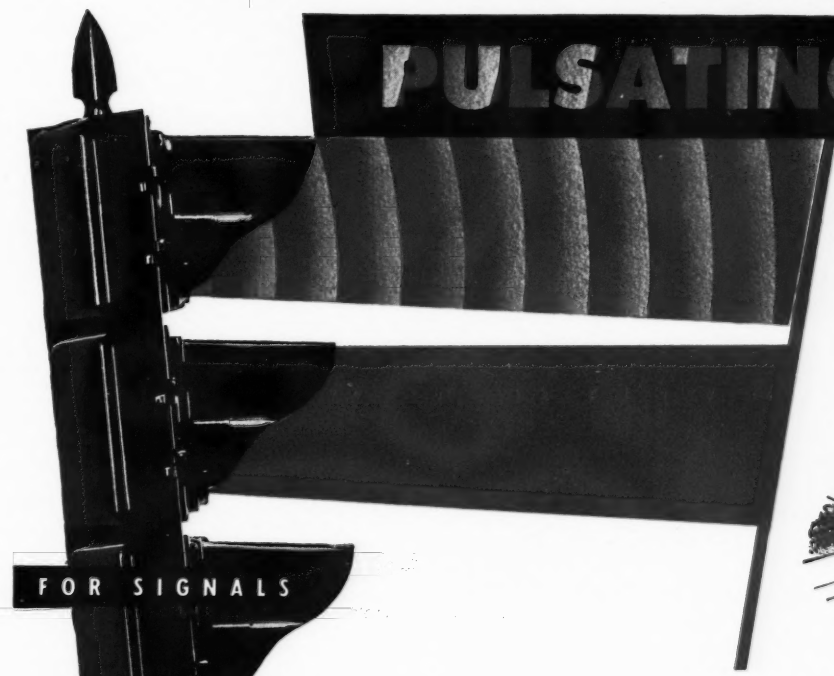
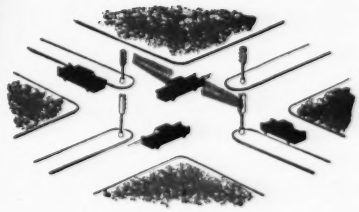
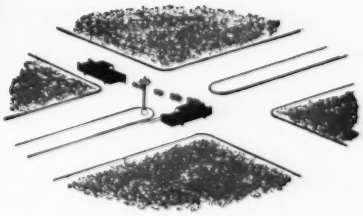
PULSATING RED







- PULSATING RED COMMANDS ATTENTION from greater distances
- PULSATING RED INSTANTLY IDENTIFIES traffic signals
- PULSATING RED PREVENTS WASHOUT from sun phantom and backlighting
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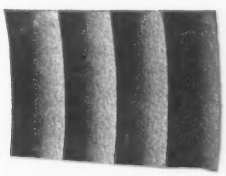

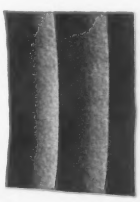

5507

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60° - 90° - 120° central angles at outside radii of 45′ - 50′ - 55′. The two "dromedarys" could not negotiate the 45-foot and 50-foot paths due to mechanical steering limitations. The standard semi-trailers were successful in all 13 test runs. These trucks were all driven by the same experienced driver throughout the test period. Periodic re-runs were made to insure the best possible accuracy.

This study indicated a significant difference in path width with increased truck length over the previous 50-foot standard vehicle. Path width increased with increased central angle turned. The previous 50-foot path data compared favorably with the 53.1-foot truck data substantiating the California study and indicated the validity of this study. A comparison of path widths with truck lengths for the controlled 55-foot outside radii, using a 90° central angle, is shown below:

Over-all Length	53.1	56	57.6	60
Maximum Path*	16.5	17.5	18.5	19.5

*Not including front overhang or allowances for a margin between truck and curb or center line.

Warning!
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This study points to the use of the 57.6-foot over-all length semi-trailer truck path for most design work. Specific scale drawings for sixteen combinations of vehicles and paths were prepared and are available from the Department. If known truck dimensions correspond to a truck used in the study, design could be based on these particular paths.

Letter to the Editor

July 28, 1958

Sir:

The July issue carried an interesting letter by Basil Andrews on 'Measuring Parking Efficiency.' the letter was prompted by my article on 'A Performance Index for Parking Facilities' in the April issue. I wish to comment on two statements in Mr. Andrews' letter.

1. "A measure of efficiency which has turnover as a factor will obscure the important effect of demand."

   It is likely that all measures of parking performance must, by necessity, obscure the effect of demand. Performance and demand are basically different factors, measured by different methods, and can hardly be combined in one index.

2. "There is some value of occupancy for which turnover is a maximum. A good measure of efficiency would be the nearness to this optimum value."

   This is a useful thought. A weakness of the Performance Index I proposed is the fact that, for a given turnover, the Index is higher for 100 per cent occupancy than for any lower value, while the optimum performance of the parking facility may well be attained at about 85 per cent occupancy, as Mr. Andrews suggests. The optimum point will vary somewhat with maximum permitted parking time.

Mr. Andrews has offered some very constructive comment. There is clearly room for additional thought and field studies on this subject.

ERIC A. MOHR
Associate Transportation Engineer
California Public Utilities Comm.

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Requirements: Graduate civil engineer with advanced course work as a traffic engineer.
Salary: $6768 to $8004.
Apply: Minnesota Civil Service
122 State Office Building
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Requirements: Graduate engineer with one year's experience or advance training in traffic engineering. Capable of planning and supervising the installation of traffic signs, signals, and markings.
Salary: $5,500 to $7,000 yearly, depending on education and experience.
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OTTAWA (CANADA)

Position: Traffic Research and Route Planning Engineer.
Requirements: Experienced man, for a permanent position.
Apply: Write, with full particulars, to the General Manager, Ottawa Transportation Commission, 56 Sparks Street, Ottawa 4, Ontario, Canada.

PEORIA, ILLINOIS

Position: City Traffic Engineer.
Requirements: Qualified man to direct traffic engineering program in city of 125,000.
Salary: $7904 to $8,294 per year.
Apply: R. V. Sipfle, Personnel Office, City Hall, 419 Fulton Street, Peoria, Illinois.

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Position: Traffic Engineer II—to assist in development of Traffic Engineering program for East Baton Rouge Parish (County).
Requirements: Graduation from college with courses in Traffic Engineering plus one (1) year's experience in Traffic Engineering.
Salary: $6300 annually with $25.00 monthly raise in 60 days.
Apply: Sidney J. Lacy, Jr., Personnel Director, City-Parish Government, P.O. Box 1471, Baton Rouge, Louisiana.

BOSTON, MASSACHUSETTS

Position: Traffic Engineer.
Requirements: Graduate Engineer with at least one year of traffic engineering experience or education. Experience in highway engineering desirable but not necessary. Live in or near Boston.
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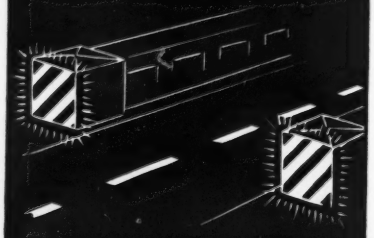

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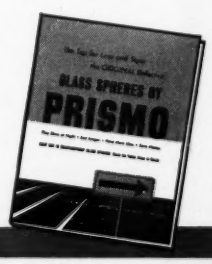

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